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INFLUENCE MACHINES.

In the Digest will be found a lengthy abstract of a recent discussion on the theory of influence machines which, we hope, may lead to the development of some rational theory to explain the action of this type of electrical generators. There seems to be abundant room for such a theory, for certainly none of those offered in the discussion can be called rational. The theory of Prof. Holtz rests upon the ancient hypothesis of two electricities, while Mr. Wimshurst unreasonably thinks it to be nearer the truth to suppose that there is but one electricity existing, there being an excess of it at one place and a deficiency at another. Mr. Schaffer believes both of these theories to be wrong and offers one of his own, which appears to be a mere arbitrary explanation of actions with no reference to their fundamental nature. In an influence machine mechanical energy is changed into electrical energy, and the manner in which this is done should admit of explanation without having recourse to hypotheses of by-gone ages, which should have no more standing in modern electrical science than the caloric hypothesis of an imponderable heat fluid has in thermodynamics. It would probably be a matter of small difficulty to get up a simple theory of influence machines based upon modern conceptions of electricity, particularly if the task were undertaken by one who recognizes the immense superiority of true physical ideas over mathematical abstractions or mathematicians' physical phantoms. The branch of static electricity, owing to a lack of industrial utilization, has remained the property of mathematicians and theoretical physicists, and is, therefore, far removed from a rational physical basis. Modern magnetism would not have been developed if it had been left to those who did not travel beyond the Ampèrian hypothesis, and it is high time to advance static electricity beyond a similar state.

AN INGENIOUS CHRONOGRAPH.

In another column will be found an interesting article by Prof. A. C. Crehore and Lieut. George O. Squier, describing a new chronographic arrangement for the measurement of the velocity of projectiles. The method is based upon the same principles involved in the apparatus of Prof. Crehore, described in our columns some months ago, for recording variable current curves, and depends upon the rotative effect of a magnetic field on a ray of polarized light passing through it. In the present instance the action of this principle was beautifully utilized as a substitute for the shutter of a photographic camera, the beam of light being extinguished by polarization when a projectile interrupted the current maintaining the magnetic field which produced the rotative effect. As remarked by the authors, this method is equivalent to the substitution of an imponderable shutter for that usually employed in taking instantaneous photographs. The article does not make it clear how the necessary allowances are made for the inductance of the circuit which contains the magnetic coil whose field produces the rotative effect, but where several screens are employed it would seem that this factor would not enter into the record. The delicacy of the method is shown by the results of the experiments made, it having thus been satisfactorily demonstrated that the velocity of a projectile continues to increase for a small distance beyond the muzzle of a gun. In the case experimented with, the point of maximum of velocity was located about seven feet from the muzzle of the gun, and as the velocity of the projectile was over 1,600 feet per second, the value of a chronographic arrangement enabling such a measurement to be made is obvious. The manner in which a continuous record may be ob-

tained from a number of screens in the path of the projectile illustrates the flexibility of the method, which promises to render it of much value in ballistics, both exterior and interior.

THE BUFFALO-NIAGARA FRANCHISE.

After what seems to be an entirely needless delay, the Buffalo municipal authorities have again taken up the matter of the terms of the franchise to be offered to the Niagara Company, and have made several notable concessions. The most important of these is in the section relating to the cost of electrical energy for municipal purposes. As originally drawn up, this section required that power should be sold to the city for $20 per annual 24-hour horse-power and that street arc lamps should be supplied for $50 per year, or current sold to the contractors for city lighting so that they could supply arc lights at that price; in the amended franchise these provisions are omitted. Another omission of importance is in the section relating to the life of the franchise, the clause governing the purchase of the plant by the city at the end of 25 years being left out thus leaving the grantee at liberty to negotiate terms when the occasion arises. Another concession permits the Niagara Company, if it accepts the franchise, to transfer it to a company to be hereafter formed for the purpose of relieving the present company of the necessity of carrying on a business of local distribution. The Niagara Company has not yet announced its intention with respect to accepting or rejecting the franchise as amended, and no grounds seem to exist now upon which it could justifiably base a refusal. Should it, however, take the latter course, it would doubtless be accused of an attempt to "bull-doze," which, however, would be merely adopting the former policy of the Buffalo authorities —a policy changed merely from a realization of the fact that it might result to its detriment by encouraging the establishment of industries nearer to the source of power. As the Niagara Company thus far has not given evidence of any unreasonable spirit, it seems probable that it will soon come to an amicable arrangement with Buffalo, and thus no longer delay a work whose successful accomplishment promises to have a most widespread influence on the electrical transmission of energy.

ELECTRICAL SUPPLY OVER LARGE AREAS.

In commenting editorially on Mr. F. L. Pope's recent Institute paper on the reconstruction of an old electric lighting plant, the London *Electrical Review* refers to the advantages of electrical supply from a large central plant to a number of towns, over the usual case where each town has its own plant. The financial conditions of small central electric lighting stations, it says, are not likely to improve rapidly so long as they are harnessed with heavy management expenses, and it thinks that the time is drawing near when we shall see a system of central management in operation, by which a number of small towns will be operated, so far as direction, management, and clerical business is concerned, from a common centre, the expenses being allocated to the different towns in proportion to the attention which they demand. With the development of alternating currents it is quite probable that what our English contemporary recommends will come to be the prevailing practice, and this before very many years. How simple the problem will be may be inferred from the success of the Pomono, Cal., plant. In this case two towns are supplied from a generating station distant respectively 13¾ and 28¾ miles, a potential of 10,000 volts being employed. In each of the towns is a transformer station in which the E. M. F. is reduced to 1,000 volts, and no attendance here is necessary beyond a visit to the station by a clerk at the time of starting and closing down. As a voltage of 10,000 has proved to be entirely practicable, a territory within a circle of 100 miles diameter can be as easily served from a central point as can one town from its own plant, employing the usual voltage. In the Pomono case each town is served from a separate alternator, but with the use of reactance regulators at the central generating point and voltmeter connections with the different centres of distribution, the system will be independent of the number of units, thus obviating a duplication of operating expenses in a score or more of towns, and combining all of the smaller units otherwise necessary into a few large ones, and situated at an advantageous point with respect to the generation of power. A great decrease in the cost of electric supply to the various towns served would undoubtedly result, while the service could be made more satisfactory through the better management that would obtain in a large central plant, having, as it naturally would, a competent professional head and skillful staff.

Inventors—An English View.

Between the adoration of the inventor, as practiced in America, and the distinct discouragement of him which is fashionable in England, there is, says the London *Electrician*, a happy mean preferable to either extreme. The widely different attitude adopted toward men of many inventions on the two sides of the Atlantic has its origin in the widely different circumstances and characteristics of the two peoples. The groove which British forbears have been good enough to provide is so broad, and has led for so long in the right direction, that it seems to most Englishmen to smack of rank heresy, not to say gross disrespect, to suggest that the groove is also deep one, and as difficult as it is desirable to get out of. This sleepy self-satisfaction results in a certain irritating obtuseness to new ideas, and, indeed, to novelty of any kind, which, although of no small utility in the painless repression of fads and faddists of all sorts and conditions, forms an atmosphere which is not exactly suited to the delicate constitution of the inventor. Even in those countries in which the inventor is encouraged by legislation and public opinion, and where invention is more or less organized and directed to definite ends, the principle of encouraging originality, admitted in theory, is with difficulty actually practiced; the effort to grasp new conceptions, the discomfort of getting out of an old rut into a new one, is too severe for most to take to kindly.

In a country, then, in which there is not overmuch legislative encouragement of the inventor, and no general public encouragement whatever, the passive and active hindrances to invention become highly effective. Again, the typical inventor of the story-book and after-dinner speech, an individual who, it must be candidly confessed, has a real corporeal existence, is not calculated to win respect in any country where the narrow business spirit predominates. To begin with, the typical inventor is usually suffering from a very severe attack of enthusiasm; a grave disadvantage where business bargains and the financial support of business men are the matters in hand. Furthermore he is, as often as not, completely ignorant of the industry which he has honored with his attentions; nevertheless, he is almost fanatical in his faith in the efficacy of and necessity for his particular device, and as a fanatic is quite unable in the nature of things to give reasons for the faith that is in him, he fares badly in the hands of any one wanting to know why it is absolutely necessary to adopt this or that improvement, and how long it will be before the returns come in. For the typical inventor, so called, it is impossible, indeed, to do more than obtain good-natured toleration.

It is not, however, says the *Electrician*, the technically ignorant or wildly enthusiastic inventor that the Americans publicly worship. A dash of enthusiasm is indeed no disadvantage, nor for matter of that a little technical ignorance; an overtrained mind is not likely to possess the freshness requisite for genuine invention. Graham Bell, Elihu Thomson, Nikola Tesla—none of whom, by the way, are American born—are typical of he character, bent of mind, and genesis of the transatlantic inventor. An inventor is as much a part of the bag and baggage of a big American manufacturing or engineering company as a works manager, head draughtsman or chief estimating clerk. They do not use steam-hammers to crack nuts with out there, and inventive geniuses are not expected to waste the greater portion of their time in deadening routine work. Not only are the pecuniary rewards large, but inventions are not, as with us, usually labelled with the name of the reigning Sovereign, or any other pointless appellation, rather than endanger the inventor's peace of mind—and his fidelity to his employers—by connecting his name with the mechanism he has devised.

The Buffalo-Niagara Franchise.

The subject of the Niagara franchise last week again came before the Common Council of Buffalo, and on Thursday redrafted provisions were sent to Secretary Rankine for adoption or rejection by the Niagara Company. The franchise as it originally passed the Council, an abstract of which appeared in our issue of May 11, has been modified in several respects.

In the original draft of the franchise, it was provided that the company agree to supply the city with electric power for its water works and other public purposes, at a rate not to exceed $20 per horse-power per annum, 24 hours per day, and to furnish street lights at a rate not to exceed $50 per annum for each 2,000-cp lamp, or to supply electricity to any one having the contract for street lighting so that he will be able to furnish 2,000-cp lamps at a rate not to exceed $50 per year. In the revised draft these provisions are left out and a single clause substituted, requiring the Niagara Company to pay annually into the city treasury a sum of money equal to 5 per cent. of its gross receipts from all electricity sold. Section 11 in the new draft merely specifies that the grant is made for the period of 25 years from the date of acceptance by the city, at the expiration of such period all rights to cease and terminate; this section in the first draft provided for the purchase of the plant by the city at the end of a period of 25 years.

Section 12 contains more liberal provisions in its revised form, with respect to transfering the franchise. By its terms the Common Council commits itself to consent, upon an application made within six months after the acceptance of the grant, to assign the same to a company organized under the laws of the State for the purpose of distributing electricity and operating under this grant, said company not to have any similar grant or any other assignment of a similar grant in Buffalo; provided that such assignment shall not take effect until the assignee shall agree to be bound by all the terms of the present grant, and a further condition that if any other assignment or transfer is made without the consent of the Common Council the grant shall become null and void. The provisions in the section relating to the repair and maintenance of pavements are made somewhat more liberal.

Electric Canal Boats.

Through E. J. Spillsbury, as manager, the Trenton Iron Works of Trenton made a contract last week with Frank W. Hawley, vice-president of the Cataract General Electric Company, for the construction and equipment of an experimental line of four miles for electrically towing boats on the Erie Canal, by means of the Lamb system.

The power is to be furnished by the Niagara Falls Power Company, and the line is to be built near Tonawanda and be ready for operation within sixty days from date of contract. The cost of the system will be about $2,500 a mile.

Mr. Spillsbury describes the system as follows: "Along each bank of the canal will be erected a pole line, the poles being of steel and extending 16 feet above the ground and outside the towpath. On top of the poles will be placed a steel cable one and a half inches in diameter. Fourteen inches below this, upon a cable wire, will be strung a second cable made of steel and one inch thick. From the upper cable a small car or traveler will be suspended, which will run on the second cable. In the car or traveler there will be a shaft, around which the tower will make three turns. The shaft will be operated by a two-phased electric motor. The current will enter the motor from the upper cable and will be discharged through the lower. A motorman will operate the car, in much the same manner as the ordinary electric street car."

President Cleveland to Open the Atlanta Exposition.

The work at the grounds of the Cotton States and International Exposition is being rapidly pushed to completion. Nearly all of the company's buildings are completed, and those still unfinished will be ready for the installation of exhibits in a short time. Arrangements have been made with the telegraph companies, by which a wire will be run to Gray Gables, and President Cleveland will touch a button at his summer home on Buzzard's Bay, which will close the circuit of an electric throttle opener attached to the engine, and start the machinery of the Fair in motion on Sept. 18.

A Chip from a True Workshop.

BY LEONARD PAGET, PH.D.

Every one is interested in the manner in which great minds operate. I have the pleasure of submitting an instance. In all our electrical science none stands pre-eminent to Gaston Planté, whose intuition was equaled only by his own power of practical deduction. The accompanying letter is self-illustrative, and stands as true to-day as when written in sunny France nine years ago. It is a powerful example of true work founded on a sound experimental basis, for the results given might have been stated yesterday, and yet have been as new as when given.

(A Letter from M. Gaston Planté to Dr. Leonard Paget.)

BELLEVUE-SOUS MEUDON, (SEINE ET OISE,)
JUNE 16, 1886.

DEAR SIR :—I received your letter of June 2, and read it with great interest. I regret that attendance to the necessary details of settling in the country for the benefit of my health has not permitted me to answer it until to-day.

Before dealing with the two questions submitted to me therein I will recall to your attention the inquiry made in your letter of Dec. 30, 1884. You then wrote to me :

"Given in an accumulator a certain weight of plate, what is the highest theoretically possible number of coulombs to be obtained, supposing the whole of the substance of the plate to be acted on? In other words, one gramme of peroxide of lead has a certain value in coulombs or ampere-hours. What is this value?"

You at the same time state that you have found this value to be theoretically 4.48 grammes.

I answered you that I found just one half, or 2.24 grammes.

But I calculated as if the peroxide of lead had been reduced to the metallic state from PbO_2 to Pb, while it is better to calculate as if the peroxide PbO_2 were simply reduced to the state of protoxide, PbO,* and in that case, in fact, we have 4.48 grammes, exactly as you have found.

You now write:

"What I want to know is what you consider the weight of peroxide actually used in your original and recent accumulators per ampere-hour of capacity?"

I think you must have meant also "and per kilogramme of lead"; for if we do not count the weight of lead cast into the accumulator, but merely the weight of peroxide of lead relative to the number of coulombs or ampere-hours it can furnish, we arrive precisely at the theoretical figure of 4.48 gr. So, if I understand your question, you wish to know how much peroxide of lead I can produce or reduce with an accumulator of a given weight (one kilogramme, for instance) and, consequently, how many coulombs or ampere-hours I can obtain.

Here is one of my latest results, which does not, however, state the utmost possible capacity of my accumulators; since, as I have often repeated, by again changing the direction of the current, we may hope to increase in that manner the capacity, which has no other limit than that determined by the internal thickness of the lead plates, or, say, one half, so as to leave a sufficient internal conducting body.

I have obtained by the discharge of an accumulator, the two plates of which weighed 1 kilogramme, a deposit of about 20 grammes of copper.

Admitting in round numbers that the deposition of 1 gramme of copper represents an expenditure of 3,000 coulombs, this would make about 60,000 coulombs per kilogramme of accumulator lead (or more than 16 ampere-hours, admitting that the accumulator is discharged exactly in one hour and that the current is constant during the entire discharge, which is not the case. Moreover, it is not exact to thus give the valuation in ampere-hours, and I prefer to simply indicate the number of coulombs obtained.) This being stated, if it is desired to know the weight of peroxide of lead, which ought to be formed during the charge and reduced (let us admit only in the state of protoxide during the discharge), we have, by taking the equivalents of copper and lead, 32 and 104 in round numbers): For 32 of deposited copper 8 of oxygen set free, which is capable of oxidizing 104 of lead, from which, for 1 gramme of deposited copper we can oxidize 5.25 of lead; for 20 grammes, 65 grammes of lead.

Thus there are only 65 grammes of lead at work at the time of discharge, corresponding to about 75 of peroxide (in round numbers), which must be formed at the time of charging.

* Which is, perhaps, more in conformity with what occurs on the discharge of an accumulator.

Now these 75 grammes of peroxide gave 60,000 coulombs ; whence, for 3,600 coulombs or 1 ampere-hour there should be formed 4.50 grammes of peroxide of lead.*

This result appears to agree with those which you have obtained on your part.

The second question which you put to me is the following :

You desire to know the force of the current in amperes with which I can charge or discharge my accumulators without inconvenience (without danger of disintegrating the formed peroxide, or the reduced lead upon the plate) that is, if I have properly understood what you call "the safe ampere charge and discharge."

I give it an approximate value of from 8 to 10 amperes per square metre of total surface of my secondary couples (counting the double surfaces of each of the plates) for the charge.

For the discharge I believe we may, without inconvenience, discharge with a notably stronger expenditure, if the end pieces or flattened parts of the plates are sufficiently thick not to become heated, and consequently get brittle, under the influence of the passage of the discharge current.

I have made no experiments with the sulphate of magnesia which you spoke of according to the results obtained by Mr. Desmond Fitzgerald. But his experiments, as well as your own, no less strongly interest me.

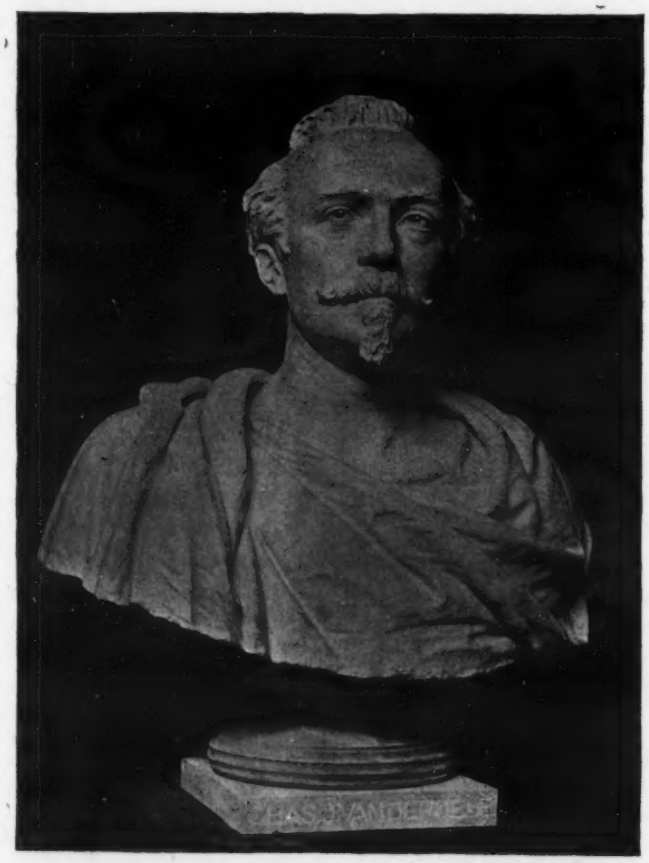
Accept, my dear sir, the renewed expression of my very marked and devoted sentiments.

(Signed) Gaston Planté.

Charles J. Van Depoele.

BY THEO. E. DE KRUYFF.

In a few weeks a graceful shaft, surmounted by a bronze bust, will mark the place where one of the pioneers of electricity is resting from his earthly labors. A finely executed monument will then be



Bust of Charles J. Van Depoele.

erected on the grave of one whose efforts, especially in the direction of electric traction, have made his name known to every student of electricity.

It will mark the grave of the late Charles J. Van Depoele, of Lynn, Mass., whose untimely death in March, 1892, in the fullness of his labors, was such a great disappointment to those—and they were numerous—who trusted that his fertile brain would still solve many problems in his chosen field of labor.

It is unnecessary to recall the services which this distinguished electrician has rendered to the world in general in trying to solve that paramount question—electric railways—as at the time of his death there was scarcely a technical paper which did not dwell on his work and did not lament that the great Destroyer had called a halt to that productive brain at such an early period.

The numerous friends of the late electrician will undoubtedly be pleased to learn that the bust—a cut of which is given herewith—is a masterpiece, and reproduces exactly the well-known features of Charles J. Van Depoele. The work has been done by a well-known artist, Mr. Robert Kraus, Studio Building, Boston, whose splendid "Boston Massacre Monument" on the Common in that city stands as the one work of art amidst the numerous caricatures with which that fine park is supplied.

It has taken Mr. Kraus several months to finish the bust, which has been on exhibition for some time in the Boston Art Museum, and will shortly be placed on a granite shaft, at the base of which will be an exquisitely executed bronze figure, and the name of the deceased, without any comment, for Van Depoele wrote his name clearly enough across the history of electricity from 1880–1892.

It is to be regretted that this artistic production is to be placed in a rather distant cemetery in Lynn, and not in a public place, where such work could be appreciated as it deserves to be, the more as it reproduces the features of one to whom the electrical fraternity owes a vast debt.

Van Depoele was one of the pathfinders in the field of rapid transit, and to his indefatigable labors and hard work—which at the end caused his death—is due, in a great measure, that great production of the last decade, viz., the electric railway, which has since revolutionized the traction systems in this country, and has made rapid transit a possibility, where the enormous expense entailed by other systems made it impracticable, save in the largest cities.

And though slumbering in the quietness of a New England cemetery, under the monument which a master hand created, the world will not overlook the services this man rendered, neither will his numerous friends forget the genial individual, whose pleasant characteristics and sterling qualities of heart made his friendship doubly valuable.

Electricity—the science of the coming time—will move onward, discovering everywhere new fields for its applications, but history will surely reserve due credit for Chas. J. Van Depoele, whose early labors made later electrical improvements possible.

A Westinghouse Combination.

As we go to press it is reported that the Baldwin Locomotive Works, of Philadelphia, owned by Burnham, Williams & Co., and the Westinghouse Electric & Manufacturing Company of Pittsburg have been amalgamated. Negotiations looking to the amalgamation are said to have been in progress for two months, and on Monday were ratified by the Philadelphia concern. On Tuesday the Board of Directors of the Westinghouse Company will take similar action.

The coalition of interests, it is stated, will result in the early introduction of improved forms of electric motors for railways, and will give employment to upward of 10,000 men in busy seasons. Although by the agreement the two companies will hereafter work as one, both plants will be retained as they are at present, extensions being made as the business shall warrant. There will be a division of the work, the Baldwin Works taking up such as is suitable to its facilities, and the electrical work will be done by the Westinghouse Company. A member of the former firm, in speaking of the combination, on Monday said:

"We have been seriously discussing the matter ever since the latter part of April, and in view of the improvements which we jointly considered the electrical developments of railways to have been, we thought it to our advantage to combine our interests, and in furtherance of that policy have concluded contracts which make a practical partnership, and we are now prepared to construct electric railways, locomotives, and everything that pertains to electrical operation of railways.

"The deal will not cause any contraction in our force of men here. We hope, on the contrary, to give work to more men, as we anticipate a greater volume of work than ever before."

The Baldwin Locomotive Works cover fourteen acres of ground, and the capacity on full working time is one locomotive in each eight hours. There are 4,900 men employed.

* If the accumulator is in continual service, my opinion is that the primary current does not have to do the entire work of peroxidation, but only the superoxidation or passage from PbO to PbO_2) of the protoxide formed upon the positive plate by an anterior discharge.

The Invention of the Electromagnetic Telegraph.—II.

BY FRANKLIN L. POPE.

AN ATTEMPTED FALSIFICATION OF EVIDENCE.

A VERY curious example of the way in which evidence is sometimes warped by unscrupulous partisans for the purpose of establishing erroneous dates may be mentioned here, as it throws a certain sidelight on the question under consideration. The evidence is abundant and incontrovertible that a successful public exhibition of Morse's apparatus was given at his rooms in the New York University on Sept. 2, 1837, a date which, it may be observed, would correspond very accurately with the statement in Morse's letter to the Secretary of the Treasury of the 27th of the same month, in which he said the apparatus had been completed and tested "within a few weeks." On the day of this exhibition, he wrote a letter, which was published in the New York *Journal of Commerce*, and which, as will be seen, refers to the exhibition as "a preliminary experiment with the register" which "recorded the intelligence sufficiently perfect to establish the practicability of the plan." It certainly does not read like an account of the exhibition of an instrument which had been completed and operated nearly two years before.*

In the "Telegraph Manual," a work written and published in 1859 by Tal. P. Shaffner, the author gives, in Chapter XXXI., what he terms the "History of the American Telegraph." On page 409 may be found the following extract under the caption of "Specimen of the Telegraph Writing."

"The writing upon the paper with the pencil or fountain pen was rapid and intelligible and practically effective, though far less so than the more modern organizations of the alphabet. The cut below shows specimens of the writing done by this plain and simple arrangement, at a public exhibition in the New York City University, at a distance of one third of a mile."

Now, it is the manifest and deliberate intention of this author to convey the impression that a public exhibition of Morse's apparatus was made on Nov. 4, 1835, on which occasion the record shown was made at a distance of one third of a mile. It will be observed that the identical wood-cut from the *Journal of Commerce* is used, but that it has been mutilated so as to read 1835 instead of 1837, by cutting off two points at the right end of the final character, and a different significat on is also conferred upon the numbers "112" from that originally given to it. Such equivocal attempts as this to falsify history by tricks of antedating are, to say the least, not particularly creditable to their authors.

The apparatus, in the form in which it was exhibited by Morse on Sept. 2, 1837, is shown and described in Mr. Jones's article, page 72, ante.

HENRY'S ELECTROMAGNET APPLIED TO MORSE'S APPARATUS BY GALE.

Now, let us go back to the time, whenever it may have been, when Morse's earliest apparatus above described was first shown to Prof. Gale, who, it may be observed, was a scientific man of considerable attainments. In the Spring of 1851, Gale, in a sworn deposition in the case of French v. Rogers, heretofore cited, testified that Morse informed him at that time, that *he could not secure a sufficient force of the electric current to operate recording machinery at a distance.* He (Gale) asked Morse if he had read Prof. Henry's article in Silliman's Journal on the subject of covering magnets with coils of wire, and that *he and Morse examined the articles together, and conversed about it, and experimented on the subject.*† At a later date, Prof. Gale gave the following more detailed account of the same circumstance:

Joseph Henry

"I accompanied him to his room, and there saw resting on the table a single-pair galvanic battery, an electromagnet, an arrangement of pencil, a paper-covered roller, pinion-wheels, levers, etc., for making letters and figures to be used in sending and receiving words and sentences through long distances. . . . At this time, as Morse assured me, no man had seen the machine excepting his brother, Sidney E. Morse. . . . Morse's machine was complete in all its parts, and *operated perfectly through a circuit of some forty feet, but there was not sufficient force to send messages to a distance.* . . . It was evident to me that the one large cup battery of Morse should be made into 10 or 15 smaller ones to make it a battery of intensity, so as to project the electric fluid. . . . Accordingly I substituted the battery of many cups for the battery of one cup. The remaining defect in the Morse machine as first seen by me, was that the coil of wire around the poles of the electromagnet *consisted of a few turns only*, while to give the greatest projectile power, the number of turns *should be increased* from tens to hundreds, *as shown by Prof. Henry* in his paper published in the *American Journal of Science*, 1831. . . . After substituting the battery of 20 cups for the battery of a single cup, *we added some hundred or more turns to the coil of wire* around the poles of the magnet, and sent a message through 200 feet of wire; then through 1,000 feet; and then through 10 miles of wire aranged on reels in my own lecture-room in the New York University, in the presence of friends. All these experiments were repeated by the original Morse machine, modified, as I have stated, by increasing the number of battery-cups and the number of turns of wire round the magnet."‡

In Morse's deposition in the case above referred to he said:

"Early in 1836, I procured *40 feet* of wire, and putting it in circuit, *found that my battery of one cup was not sufficient to work my instrument.*"

This of course would equally have been the case with 10 cells, or with 100, unless the electromagnet had been reconstructed upon the plan first made known by Prof. Henry.

MORSE'S TELEGRAPHIC INVENTION FORMULATED.

In view, therefore, of the prior state of the art, as disclosed in prior patents, publications and public uses, what was Morse justly entitled to claim under the patent law, on Sept. 2, 1837?

It would seem to be beyond question that he was entitled to make some such claims as the following:

1. A device for marking or imprinting signs or characters, and a surface for receiving such signs or characters, capable of relative movement in two planes perpendicular to each other, in combination with an electromagnet, armature and retractor for effecting said movement in one plane, and with any suitable motor for effecting said movement in the other intersecting plane.

2. An electromagnet, armature and retractor, in combination with mechanism for imprinting signs or characters upon a suitable surface when controlled by the action of said electromagnet.

3. An electromagnet, armature and retractor, and mechanism controlled by said electromagnet for imprinting signs or characters upon a suitable surface, in combination with an electric circuit, a source of electricity and a circuit-breaker.

4. An electromagnet, armature and retractor, and mechanism controlled by said electromagnet for imprinting signs or characters upon a suitable surface, in combination with an electric circuit, a source of electricity, a circuit-breaker, and a movable pattern-device for automatically controlling the movements of said circuit-breaker.

5. The art of marking, printing or recording signs or characters, which consists in alternately interrupting and restoring the flow of

* Vide *Journal of Commerce* letter in preceding article by F. W. Jones.

† French v. Rogers, Compt's evidence, p. 440.

‡ Memorial of S. F. B. Morse, Washington, 1875, pp. 15-17.

a normally continuous current in an electric circuit at determinate intervals of time, and in producing corresponding marks or impressions at a distant point upon a moving surface by the physical action of said current.

6. An electric circuit which is alternately opened and closed by mechanism actuated by the action of an intermittent current traversing another circuit.

7. A numerical code, in which each digit is represented by one or more of four elements, viz., a short line or dot, a longer line or dash; a space corresponding in length to the dot, and a space corresponding in length to the dash.

In a letter written by Morse under date of Sept. 25, 1868, he

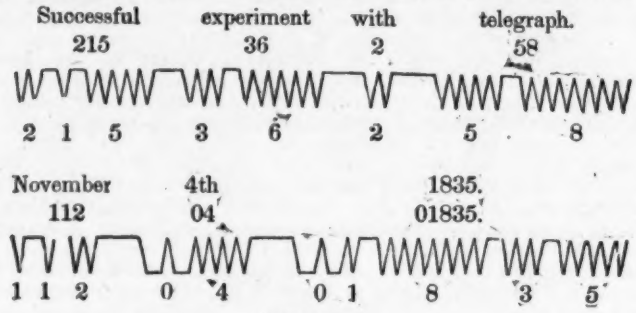


Fig. 1.

gives in a few words what may justly be regarded as his matured conception of the scope of his own invention. He says:

"The idea of the possibility of using electricity as a means of communicating at a distance may have been a century old, but that was not my idea of 1832. The idea of 1832 was the possibility of *producing an automatic record at a distance by means of electricity*—the idea of a true telegraph—and this original idea was immediately followed by devising the process and means for carrying the idea into effect."*

What Morse had really accomplished, prior to Sept. 2, 1837, was to add to Henry's apparatus of 1831 two new elements, first, *a system of signs* having an arbitrary signification, and, second, a mechanism actuated by the moving armature of Henry's apparatus, which not only produced sounds, as Henry had done, but also *marked or imprinted corresponding signs*, thus producing for the first time a *recording telegraph.*

MORSE'S INVENTIVE ABILITY.

A certain disposition has always been manifested among persons inimical to the interests of the telegraph patentees, to seek to underrate Morse's ability as an inventor. The opinion has already been expressed in this paper, that the sketches made by him on board the *Sully* give evidence of inventive ability of a very high order. It is true that he apparently possessed but a moderate amount of constructive skill, but it must be remembered that

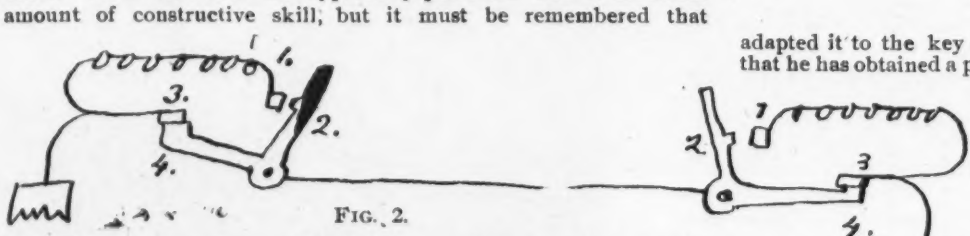


Fig. 2.

inventive and constructive skill have no necessary relation to each other in the case of any given individual. Further evidence of Morse's inventive turn of mind crop out here and there in his correspondence. For example, in a letter to F. O. J. Smith, of March

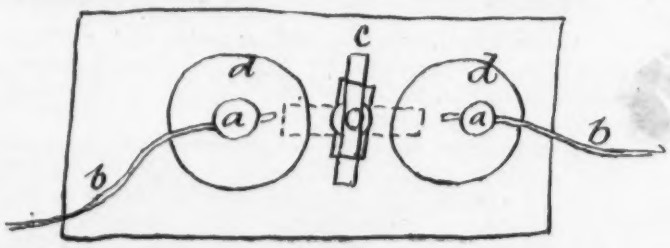


Fig. 3.

12, 1846, who was then engaged in getting the Boston line into operation, Morse says:

"Soon after the single key was adapted to my instrument, to avoid the plague of mercury, I adapted the same effect to an elbow of metal as a key. (See Fig 2.)

"Cornell has either taken a hint from this mode of mine and

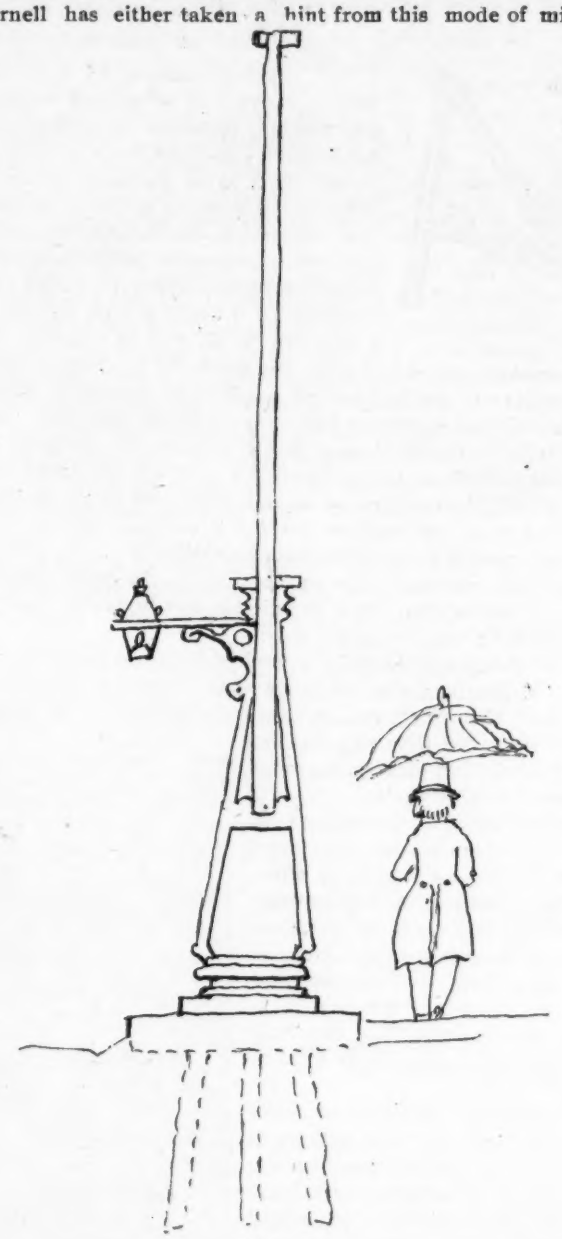


Fig. 4.

adapted it to the key of my instrument (for you are perhaps aware that he has obtained a patent for a mode of breaking and connecting a battery with the main circuit) or he has devised from his own head a clumsier and more complicated mode of accomplishing the same end. Colt insists that he explained this mode to Cornell long ago."

The accompanying facsimiles of sketches of other devices were made by Morse at about the same date. One is a cut-out for short-circuiting the helix of the relay, and the other is a suggestion for a combined street-lamp and telegraph post for city use, which is not without interest. Many other similar instances might be added.

ALFRED VAIL AND HIS INVENTIONS.

Alfred Vail gives the following account of his connection with the enterprise:

"On the 2d of September, 1837, the author with several others witnessed the first exhibition of this electric telegraph, and soon after became a partner with the inventor. Immediate steps were taken for constructing an instrument for the purpose of exhibiting its powers before the members of Congress. This was done at the Speedwell Iron Works, Morristown, N. J., and exhibited in operation with a circuit of two miles. A few days after it was again exhibited at the University of the City of New York, for several days, to a large number of invited ladies and gentlemen." *

CONFLICT OF EVIDENCE AS TO VAIL'S FIRST MODEL.

There is a conflict of evidence as to the character and construction of the instrument above referred to which was exhibited first

* Paris Exposition report on Telegraphic Apparatus, Washington, 1869.

* Vail, "Electromagnetic Telegraph," p. 145.

in Morristown, then in New York and Philadelphia, and finally before a committee of Congress in Washington. A contemporaneous account of the exhibition of Jan. 11, 1838, in the *Morristown Journal* informs us that "the words were put up into numbers through the dictionary; the numbers were set up in telegraph type

MORSE IN HIS OLD AGE.

in about the same time ordinarily occupied in setting up the same in a printing office; they were then all passed complete by the port-rule, . . . and by means of the dictionary were resolved again into words."

The manuscript diary of Alfred Vail, now in the possession of his descendants, says of this Speedwell machine:

"It consisted of a single drum about three inches in diameter which opened through its centre. When it was designed to put paper on these two half-drums, the paper was inserted in a clasp on the side of each half drum, which shut down, holding the paper fast. The two half drums were then . . . placed on the square cast-steel shaft, and when brought together . . . drew the paper tight to the outer surface of the drum. When on the shaft the spiral on the drum moved in a toothed rack below and thus carried the paper along making a sort of spiral written line. There were two machines of this kind. . . . These two instruments were put up in a vacant room connected with the works, and exhibited to the ladies and gentlemen of Morristown. A few days after this exhibition the instruments were taken to New York and set up in the mineralogical lecture room of the University. Here three days of exhibition were given to invited ladies and gentlemen. The instruments were worked through 10 miles of wire. *At this time the pencil was used* for marking the paper fastened on the cylinders as previously stated."

These same instruments were successively taken to Philadelphia and Washington, and were exhibited before the Committee on Commerce. It was at this time that Hon. Francis O. J. Smith, then chairman of that committee, first became interested in the invention, as will be hereafter related. In April, preparations were commenced for a trip to be made by Morse and Smith to Europe to obtain foreign patents and dispose of the invention abroad. Vail was at the same time dispatched to Speedwell to prepare the necessary instruments. His diary continues:

THE QUADRUPLE FOUNTAIN PEN REGISTER.

"On my arrival at Speedwell, two instruments were commenced *on a different plan* from that so recently exhibited at Washington. The paper was to be *ribbon paper* and the *pens to hold ink* instead of using the pencil as in the former case. . . . The pen was made by taking a piece of plate-brass . . . slitting the plate into two plates for about one half its width, and then sawing with a fine saw the opposite edge in four equally distant places until the cut reached the parallel division. The spaces were filed to a point so as to form pen-points and the wider saw-cut was then stopped at its two ends so as to form a reservoir for the ink. This, soldered to the end of the magnet lever, was used as a pen for making *four dots or lines on paper* instead of a pencil as in the former case. The paper was made to pass over a cylinder directly under the pen, so as to make the proper marks. The paper was driven by a clock-train as in the other cases."

The statement in Vail's diary is confirmed by a letter which he wrote about this time to Hon. F. O. J. Smith, then in Portland, Me., to which is attached a sample of the writing of the four-pointed pen, which he says had just been completed.*

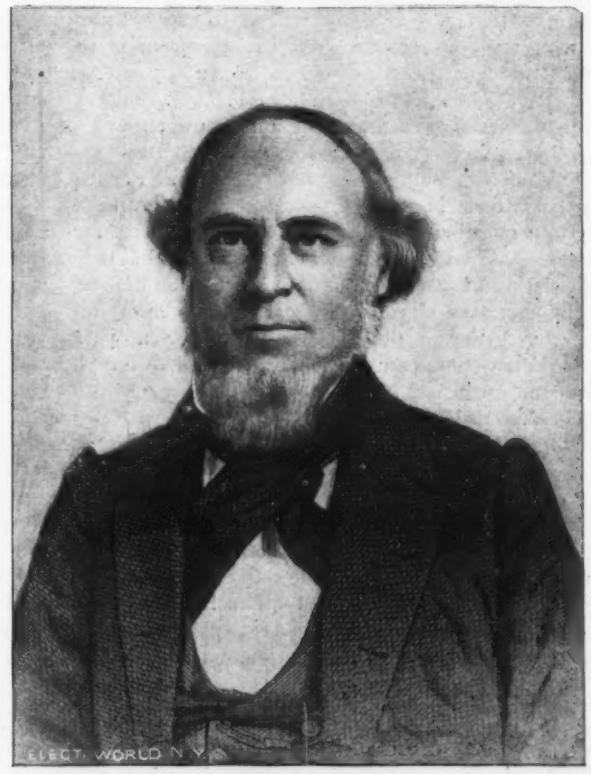
On the contrary Morse, with equal positiveness, states:

"The form of the fountain pen was like that shown in the annexed figure. This gave the dispatch with a three-fold line, so that in case one pen should be clogged and fail to record, one or both the other pens secured the record. This method for some time produced good results. *It was the mode exhibited to the Congress at Washington in the session of 1837–38*, and to the Academy of Sciences in Paris in 1838, described by M. Arago from its appearance as '*un petit rateau*', or little rake."

Dr. Prime, the biographer of Morse, gives a facsimile of a dispatch printed in the characters of the modern alphabetical code, with a four-pointed fountain pen, which he states to be the first sentence ever recorded by the telegraph which has been preserved, and to have been transmitted on the occasion of the exhibition above alluded to which took place in the New York University on Jan. 24, 1838.† This is stated to have been preserved by Gen. Thomas S. Cummings, who was present on the occasion by invitation. The conclusion seems irresistible, that there must be some error in respect to this matter, for the four-pointed pen instruments if Vail's diary and contemporaneous letters are to be believed, was an improvement of later date,‡ and hence Morse himself must be in error in stating that an instrument producing dots and lines was shown at Washington in 1837-38. The contemporaneous correspondence of Vail, Smith and Morse, moreover, proves that Morse saw this four-pen dot-and-line marker instrument for the first time on the occasion of a visit to the Speedwell works on April 11, 1838, about a month before his departure for Europe.

THE EMBOSSING REGISTER.

Between the date of the close of the exhibition in Washington and that of the formal opening of the experimental line between Baltimore and Washington on May 27, 1844, a number of very important modifications and improvements were made in the apparatus, which may now be considered.



F. O. J. SMITH.

In a letter written by Hon. Francis O. J. Smith to the regents of the Smithsonian Institution, on March 30, 1872, he makes the

* A facsimile of a sample of recording by this machine is given in an article by the writer in *Century Magazine*, XXXV., 937.

† Vide Mr. Jones's article and Fig. 5. p. 154 ante.

‡ It should also not be overlooked that the Cummings dispatch is written in the same alphabetical code which is in use at the present day, which unquestionably must have been of more recent origin than the quite different one given in Morse's patent of 1840 (reproduced in Mr. F. W. Jones's article), which must have been filed on or about April 7, 1838, nearly three months subsequent to the date of the exhibition in New York at which the dispatch is claimed by Dr. Prime to have been transmitted.

following statement in rejoinder to certain published statements of Prof. Gale, in the Washington Sunday *Chronicle* of March 3, 1872:*

"Prof. Henry stands out rightfully on the page of history as the first discoverer of the scientific principles, and the first inventor of the primary mechanical principle in combination with that scientific principle, which constituted the electromagnetic telegraph of 1837-38, and which Prof. Morse now claims was first combined for that purpose by himself alone.

"All that was needed to perfect this invention into a successfully recording telegraph, as well as a sounding telegraph (to which latter the American telegraph has now almost everywhere been reduced in practice), was the invention of a steel style in the extremity of the sounding-lever of Henry, and a grooved roller into which it could strike the paper as it was drawn onward over the roller to emboss upon it the alphabetical characters, neither of which, as Prof. Gale unquestionably knows well, were invented until 1844; and then *neither invented nor combined in the telegraph by Prof. Morse, but exclusively by our associate, Mr. Alfred Vail*, although, for reasons that will be satisfactory to most minds, they were never publicly credited to him, but have been claimed by Prof. Morse as his own invented combination! Although Mr. Vail is now dead, he still lives for all the purposes of this most significant fact, and will speak audibly from the grave, when summoned by Prof. Gale's denial, and in language that will have no double meaning.

"Who, too, invented the first combination of the horizontal lever motion to actuate a pen or pencil or style, and the entirely new telegraphic alphabet of dots, spaces and marks which it necessitated, in September, 1837, and combined them in the American telegraph of that date, supplanting the unsuccessful pendulum motion and its one kind of mark (V) both of which Prof. Morse undoubtedly did invent? Will Prof. Gale disclose this great secret without recourse to Mr. Vail's records? *He knows the new mechanical change that was then wrought, and who suggested it and who worked it out?*"

CHARACTER OF F. O. J. SMITH.

A sense of justice compels me to say that the uncorroborated statements of F. O. J. Smith, in any matter affecting the credit or honor due to Prof. Morse, should be allowed but little weight. However fortunate it may have been for Morse that he found a member of Congress capable of appreciating the future possibilities of his invention, and able and willing to use his political influence in getting an appropriation from the government to set the enterprise on its feet, it was assuredly most unfortunate that that man should have chanced to have been F. O. J. Smith. Smith was a lawyer of far more than average abilities, a shrewd politician, and while by no means destitute of good qualities, was nevertheless grasping, selfish, pugnacious and relentless. For no better reason than that Morse, in 1843-44, courteously but firmly refused to be a party to a questionable scheme devised by Smith for the irregular diversion into his own pocket of a portion of the governmental appropriation of $30,000 for the construction of the experimental line, he ever after cherished toward the inventor the bitterest animosity; a feeling which he took little or no pains to conceal. Many of his letters to him, at that time, and for years afterward, were couched in studiously insulting language which must have been in the highest degree irritating to a sensitive artistic temperament like that of Morse. It probably by no means tended to mollify the disposition of such a man as Smith to find that Morse, in his replies to these covert sneers and open insinuations, never once lost his self control, nor permitted himself to depart from the dignified tone of rejoinder and remonstrance which becomes a gentleman in his dealings with one who, in his inmost nature, was essentially a blackguard. It was almost solely in consequence of the persistently arbitrary and belligerent policy of Smith, which the other co-proprietors of the patents found themselves wholly powerless either to control or restrain, that the newspapers and the people of the whole country, almost without exception, ultimately became bitterly hostile to all legitimate telegraph enterprise, and threw the whole weight of their vast influence in favor of infringing rivals, so much so that it may safely be affirmed that neither Morse nor Vail ever realized from the telegraph patents one tenth of the revenue to which they were legitimately entitled. Thousands of miles of lines were constructed and operated for years through the best paying telegraph districts of the United States for which the patentees never received the first cent for their lawful rights, while on the other hand, the stockholders of these lines as well as the general public were remorselessly plundered on every side. There is abundance of contemporary evidence to prove that both Morse and Vail never ceased to deplore and deprecate this shameful condition of affairs, and that they made earnest, though fruitless efforts to put an end to it. It is said that at the time of the general consolidation of telegraph interests in 1859-60, Smith was paid the sum of $350,000 to withdraw himself from the telegraph business, and was put under heavy bonds to keep out of it, but he was nevertheless in the field with an opposition line from New York to Portland, under another name than his own, within a twelvemonth!

Mr. Smith died on Oct. 16, 1876. For some time before his death he had been diligently engaged in collecting and arranging material for a proposed history of the American electromagnetic telegraph from his own point of view. Among his papers was found, after his death, extracts made by him from certain letters which had been written by Alfred Vail in his lifetime to Amos Kendall, who had acted for many years as confidential attorney for Prof. Morse, and also during a portion of the time for Vail himself. The "voice from the grave" to which Smith makes mysterious allusion in the above quoted extract, presumably refers to these letters.

(To be continued.)

* See extract from Gale's letter in Mr. Jones's article, p. 108, ante.

Survival of the Fittest.

Attention has been called, says the *Engineering and Mining Journal*, to the disastrous results, both direct and indirect, of the enormous inroads of electricity in street railway traffic, displacing horses, and to a lesser degree in mine haulage replacing mules. The effect on the farmers who raise horses and mules and the grain necessary for their subsistence, and on the railways which transport this grain, is looked at as a very serious matter. As is usually the case, however, the favorable balance is more than maintained by increased activity in other lines, due directly to the same causes. The production of copper, for instance, is enormously increased by the demands of the manufacturers of electric apparatus, and its transportation, together with the carrying of the finished products, makes an enormous freight tonnage. The auxiliary lines, so to speak, such as mica mining, asbestos mining, iron mining and the metallurgical processes producing iron, steel and copper, have all received their share of the impetus due to electrical development. So while the farmer may suffer in furnishing the supplies for horses and breeders, still he would gain in the general growth of industry requiring more men and more material of various kinds. Every improvement hastens the death of some industry unfit to survive, while it creates many new wants and increases the general prosperity.

A Mayor as a Motorman.

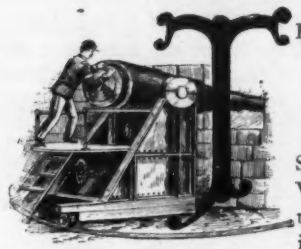
A certain English duke, not long deceased, was never so happy as when he was driving a railway locomotive at a 60-mile-an-hour gait. Naturally, he was liked by the masses for his skill and daring as well as his democratic tastes. His prototype has appeared in this country, in the person of Mayor Pingree, of Detroit, who, dressed in the full uniform of a motorman, ran the first car over a new electric railway in that city. The local papers lay great stress on the fact that the mayor manipulated the car entirely himself, and that "he juggled the controller and twisted the brake; he rang the bell, and bumped into express wagons. He ran past the corners where passengers wanted to get off, and failed to stop for passengers that wanted to get on. In fact, he did everything in his power to imitate the ways of the professional motorman." The amateur car driver received an ovation all along the line, and his re-election to the mayoralty is now spoken of as certain.

A Pleasant Journey to the Atlanta Exposition.

A party of newspaper men and ladies have arranged a house-boat party, to leave New York City on Sept. 1., for the Cotton States and International Exposition. The route which they take is a good illustration of the facilities for water travel through the Union. The boat's dimensions are 30 by 12 feet, and the greater part of the distance will be poled. The route as outlined, will traverse the Hudson River, from New York to Albany; thence by the Erie Canal to Buffalo; thence to Cleveland, along the shore of Lake Erie; thence to Portsmouth, O., by the Ohio Canal, where the Ohio River will be taken to the Mississippi, and the latter down to some convenient point, probably Memphis. From there, the railway will be taken to Atlanta, where the party will arrive on the Sept. 18, the opening day. The party proposes to have a great deal of pleasure along the route as well as at the destination.

Measuring the Velocity of Projectiles.*

BY ALBERT C. CREHORE AND GEORGE O. SQUIER.



THE object of the experiments described below was to test a new instrument as applied to the measurement of the velocity of projectiles. These experiments were conducted at the United States Artillery School, Fort Monroe, Va., in January, 1895. The instrument referred to is a modified form of the instrument, already described in these columns,† devised by one of us for the measurement of any kind of a variable current.

It may not be evident at a glance what the relation is between an instrument which will accurately measure a variable electric current and the measurement of the velocity of projectiles. In regard to this it may be said that any good instrument for measuring a variable current, possesses the essentials of a chronograph, and a chronograph is the essential instrument for measuring the velocity of projectiles. A good current measurer must give sufficient data to construct a curve, the horizontal axis representing time and the vertical axis the current. The time intervals between any phenomena can therefore be measured by such an instrument, if the phenomena referred to are capable of either interrupting the electric current or changing its strength in any way.

The superiority of this instrument over other known methods of measuring currents is due to the fact that in recording a variable current, no *ponderable matter* is required to be moved, as is the case with all other instruments for this purpose. Many examples of other instruments might be mentioned, but in each case a certain amount of ponderable matter possessing inertia is required to be moved.

For the purpose of a chronograph the original instrument is simplified by omitting the part of the apparatus producing the spectrum, and by recording instead the persistence and interruptions of the white light emerging from the analyzer. The nature of this instrument is such that it is admirably adapted for recording the passage of the projectile at a number of points of its trajectory, which points of observation may be as near together as is desirable. For this reason it was made an object to study the *law of variation* of the velocity of the projectile near the muzzle of the gun. Observations were generally taken within a distance of 45 feet from the muzzle, at various regular intervals. As many as 10 observations at regular intervals of only five feet, beginning at the muzzle of the gun, and extending to a distance of 45 feet, were obtained. From measurements on the negatives it is clearly evident from each that the velocity of the projectile actually increases after leaving the gun. This is a fact which has long been suspected, but so far as we know has not previously been demonstrated experimentally.

This method of measuring the velocity of projectiles is the same in one essential particular as the methods now practiced. The projectile passes through screens, and the velocity is obtained from the two independent measurements of the distance between the screens and the time interval. As a chronograph the instrument has a wide application to many phenomena of nature, besides the single application to the measurement of the velocity of projectiles.

The desirable and possibly essential features of a good chronograph may be classed as follows: There must be some agent in the first place which can transmit, from the phenomenon to be recorded, wherever it may be located, the occurrence of the event to a place where it can be permanently made a matter of record. In the second place, the agent which is to receive the record must include with it some accurate means of measuring time. For brevity let us designate these two parts of any chronograph by the terms "transmitter" and "receiver."

The particular form of transmitter used in these experiments depends for its action upon the use of polarized light.

Let us admit a beam of sunlight through a small aperture into a dark room, and let it fall upon a sensitized photographic plate. If the plate is moved transversely across the beam, it will be found that the negative shows a continuous band of light. Now, suppose that the aperture which admits the beam of light is provided with a shutter that can be opened or closed at will. As the sensitive plate moves across the beam, let the shutter be successively opened and closed. The negative now shows an interrupted band of light, alternately light and dark, due to the opening and closing of the shutter. If the beam were admitted to the plate through a narrow slit, it would be possible to make the band of light stop off suddenly at a definite point on the negative.

If it is known just how fast this sensitive plate moves across the beam, it would be easy, by measuring the distance between two points on the plate, to measure the time intervals between the open-

* For a detailed account of these experiments see "Journal of the United States Artillery," July, 1895, Fort Monroe, Va.—*Physical Review*, July-August, 1895.

† "A Reliable Method of Recording Variable Current Curves," by Dr. A. C. Crehore, THE ELECTRICAL WORLD, June 30, 1894, "Transactions of the American Institute of Electrical Engineers," October, 1894.

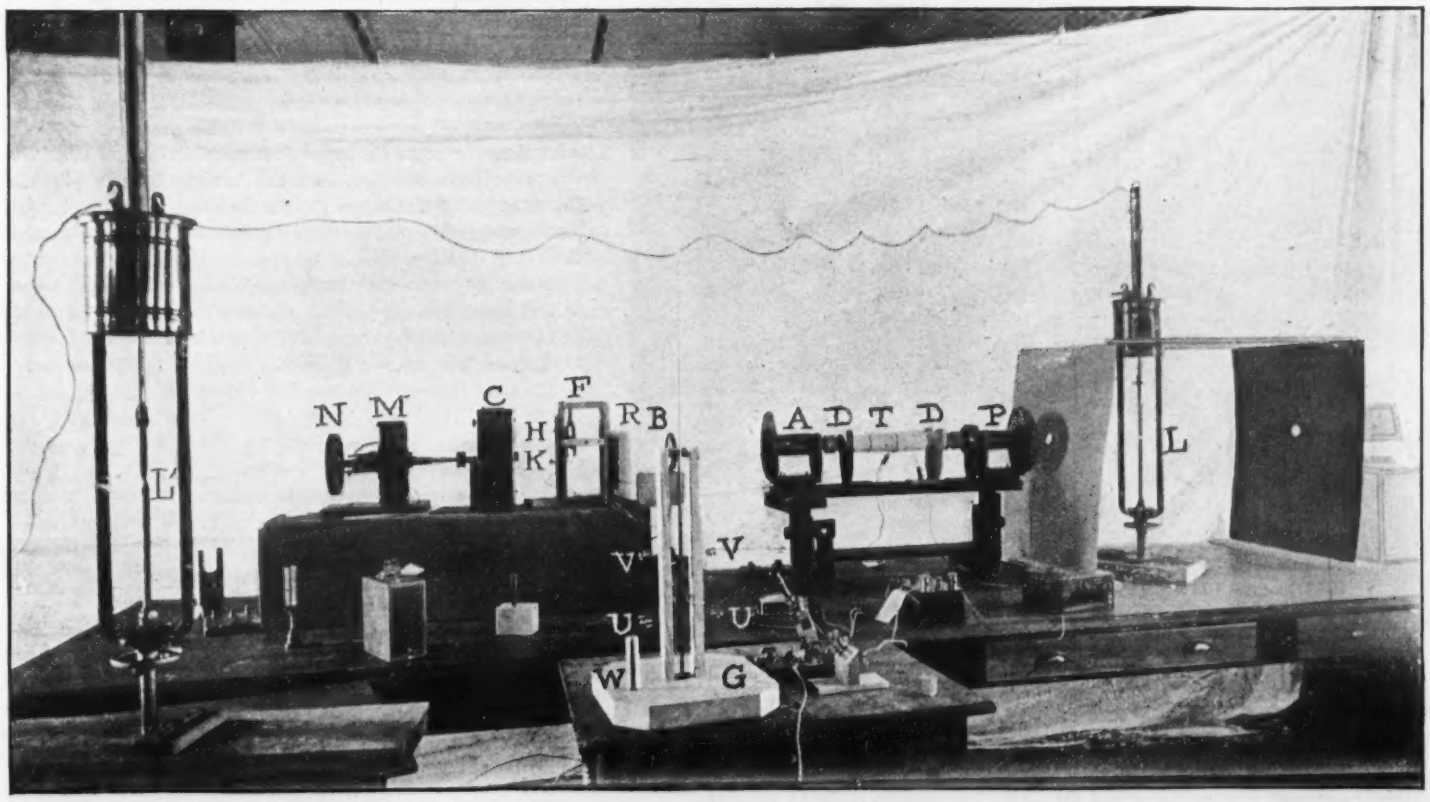


FIG. 1.—LABORATORY ARRANGEMENT OF APPARATUS..

ing and closing of the shutter. Again, the shutter might be operated by some agent whose time interval we desire to know, and thus a measure of it is obtained. If the shutter could be manipulated quickly enough by a projectile, we might thus measure its velocity. But if we should attempt to make any *material* shutter, that necessarily possesses a certain amount of *inertia*, move back and forth at the instant the projectile passes a screen, we must surely fail. The experiment is more successful, however, when we use a shutter that has absolutely *no mass*. This is the kind of shutter which was used in these experiments, and it was with this object in view, to obtain a massless shutter, that we have made use of polarized light.

In the path of the beam of white light admitted through

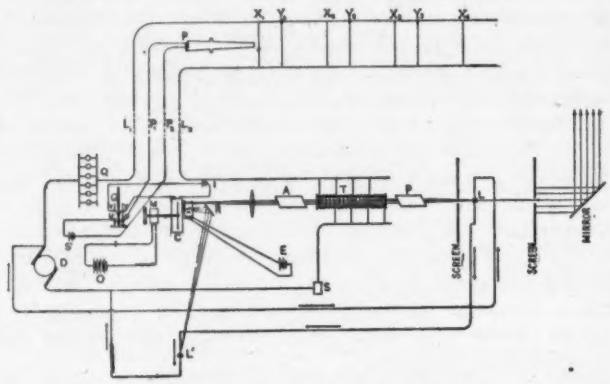


Fig. 2.—Diagram of Circuits.

the aperture is placed a Nicol prism (any other means of obtaining polarized light may be employed), in order to obtain a beam of plane polarized light. An analyzer, consisting of a similar Nicol prism, is placed in line with the polarizer. As the analyzer is rotated about the axis the transmitted light varies in intensity from total extinction in one position to maximum brightness 90 degrees from it. The analyzer as used for the chronograph is permanently set for total extinction.

In order to accomplish the same end that is obtained by rotating the analyzer without actually doing so, the following means is adopted: Between the polarizer and analyzer is placed a transparent medium which can rotate the plane of polarization of the light subject to the control of an electric current without moving any *material thing*. The medium used in these experiments was liquid carbon bisulphide, contained in a glass tube with plane glass ends. There are many other substances which will answer the purpose, some

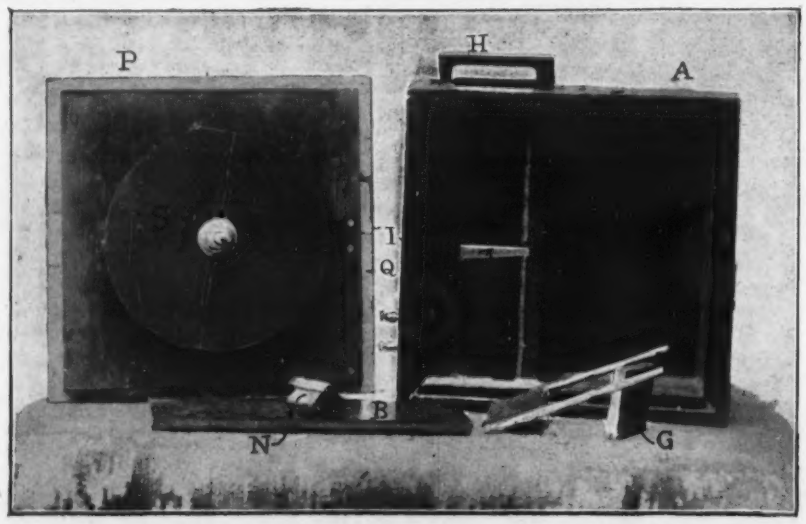


Fig. 4.—Details of Camera.

better than others. This was selected because it is very clear and colorless, and possesses the necessary rotatory property to a considerable extent. It only possesses this property, however, when situated in a magnetic field of force. The rotatory power is proportional to the intensity of this magnetic field.

To produce a magnetic field in the carbon bisulphide, a coil of wire is wound around the glass tube and an electric current passed through the coil. When the current ceases the carbon bisulphide instantly loses its rotatory power. The operation is as follows: First the polarizer and analyzer are permanently set in the crossed position, so that no light emerges from the analyzer. A current is now sent through the coil on the tube. The plane of polarization is rotated. This is equivalent to rotating the polarizer through a certain angle, and hence light now emerges from the analyzer. Break the current, the medium loses its rotatory power and there is again

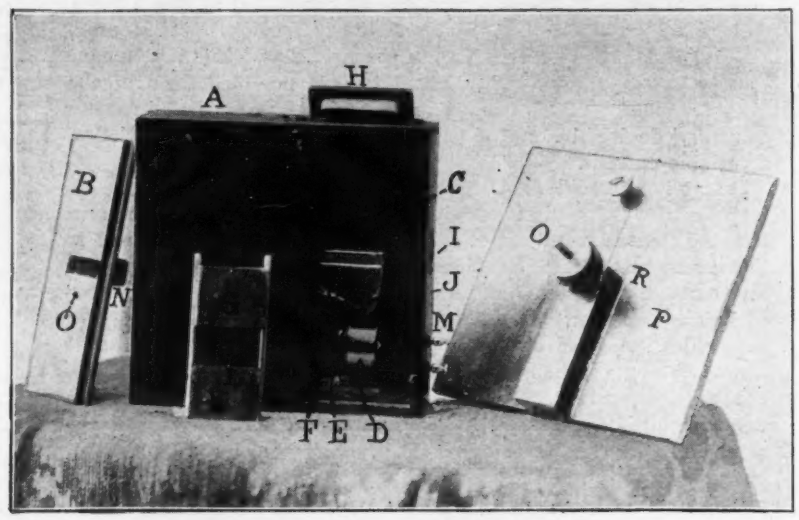


Fig. 3.—Details of Camera.

complete darkness. This arrangement makes an effectual shutter for the beam without moving any mass of matter.

The whole time of transmitting the phenomenon to the receiver may be thought of as consisting of three distinct operations, which occupy three successive intervals, as follows:

1. The interval due to change in the current. 2. The lag of the magnetic field in the solenoid behind the current which caused it. 3. The time occupied by the rotation of the plane of polarization, and the transmission of the light from the transmitter to the receiver.

The receiver is that part of the chronograph which is susceptible of receiving the continuous record from the transmitter, and it also includes that part of the instrument which measures time. In these experiments it consisted of a circular photographic plate upon a horizontal shaft in a dark box. An approximately uniform rotation was given to it by means of an electric motor, whose armature was coupled directly to the shaft. In order to accurately determine the angular velocity of the plate, whenever it is exposed, a tuning fork is placed so that the shadow of one prong is projected sharply upon it by means of a parallel beam of light from an intense source. The light from the transmitter, as well as the light from the tuning fork, is admitted to the plate through a narrow horizontal slit. When the plate is in rotation, and the tuning fork is vibrating, the shadow of the edge of the fork describes a sinusoidal line around the plate. From a knowledge of the angle on the plate which a certain number of these waves subtend, and the time of vibration of the fork, the angular velocity of the plate at once becomes known. The real time measure is thus a tuning fork, which is a most reliable method of measuring time. Moreover, the speed is in each in-

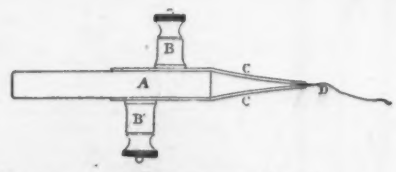


Fig. 5.—Make-Circuit Device.

stance recorded upon the plate, so that the necessity of measuring the speed before and after the observation is avoided.

It need not be said that the various parts of both the transmitter and receiver might be constructed in other and better ways; and the manner of their use and operation modified in many particulars, which it would be out of place to describe here.

The gun used was a 3.2-inch breech-loading field rifle of 25.2 calibres length, and the service charge of 3¼ lbs. of powder was uni-

formly employed. The projectiles were common shell, so selected that each weighed 13 lbs. 6 oz.

Fig. 2 shows the complete arrangement of the electrical circuits and apparatus. The broken lines L_1 L_2, P_1 P_2, connect the interior laboratory apparatus in the lower part of the figure, with the gun and system of screens at the proving ground in the upper part.

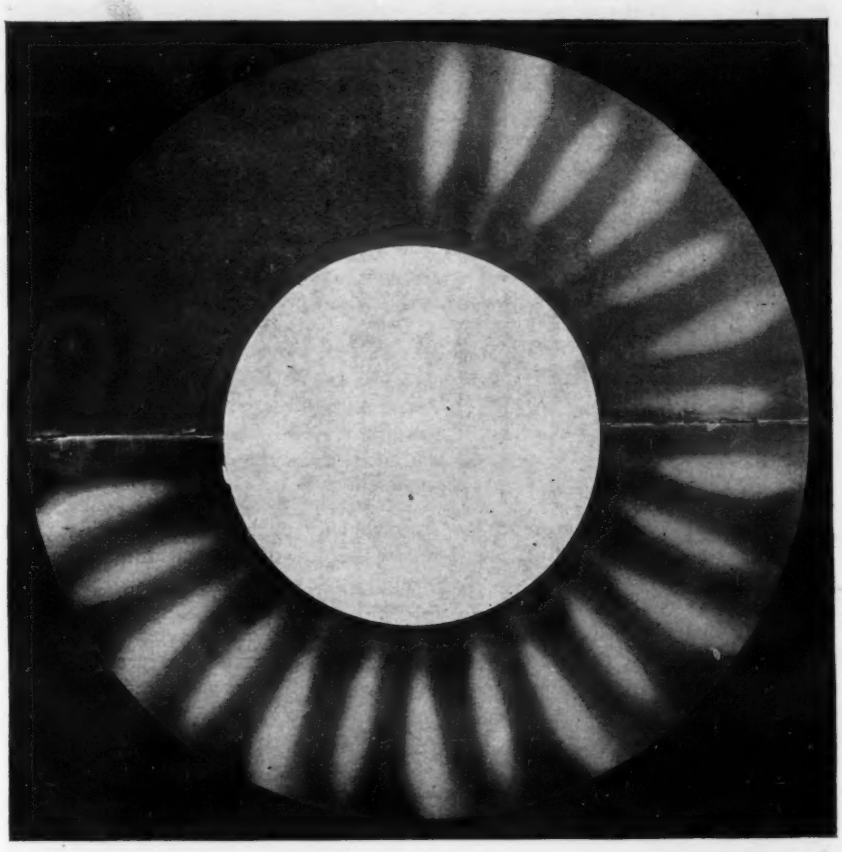


FIG. 6.—ARC LIGHT CHRONOGRAPHIC RECORD.

A view of the laboratory apparatus is shown in Fig. 1, in which corresponding letters represent corresponding parts in the two figures.

L and L^1 are arc lamps used as light sources. Sunlight may be used. P is the polarizer, T the transmitter tube, containing carbon bisulphide, A the analyzer, in front of which is a lens to condense the beam upon the camera C. The motor M revolves the sensitive plate in the camera. The speed of the plate is obtained at the moment of firing by the shadow of one prong of a tuning fork, run electrically by the cells E, cast by a beam from the lamp L^1 reflected from the minor R upon the sensitive plate.

At X_1 X_2 X_3, etc., placed at regular intervals from the gun, are wire screens which are cut in succession by the projectile.

At Y_1, Y_2, Y_3, etc., are placed devices for mechanically restoring the current shown in Fig. 5. Before firing, the current passes only through the screen X, because of the small insulating plug D, placed between the jaws of the device, which interrupts the connections between X_1 and X_2; X_2 and X_3, etc.

When the projectile strikes the wires attached to this insulating plug, it is pulled out and the jaws spring together, thus establishing the circuit through X_2.

The receiver is a photographic means of recording the intermittent beam of light through the analyzer, and consists of a camera containing a sensitized plate, which is shown in position ready for use at C (Fig. 1). Detailed views of the camera are shown in Figs. 3 and 4. It is made of wood in the shape of a rectangular box, the interior limensions being 10″ high by 10″ wide by 2.5″ deep. Figure 6 represents the front view of the camera-box A with the cover B removed, showing the small auxiliary dark chamber C, which contains the electromagnetic device D, with armature E attached to the brass spring F for releasing the camera-slide G. This slide is shown in the photograph; withdrawn from the grooves in which it normally slides by passing it through the opening at the top after removing the cover H. The narrow horizonal slit through which light is admitted to the photographic plate is shown at I.

When the camera-slide is in position, the nail at K rests upon the top of the brass spring F, and the upper edge L of the lower screen of the slide covers the slit I. When the current passes through the electromagnets by the binding posts M, the armature is drawn and the slide released. The slit is exposed only while the opening in the camera-slide is passing by.

When the camera-slide comes to rest, the upper screen G covers the slit and it remains so covered. The upper screen G is capable of adjustment along the brass rods of the slide, and the opening between the upper and lower screen of the camera-slide is thus adjustable, and the time of exposure of the slit under control.

The wires shown at O are for the purpose of producing on the plate reference circles by casting their shadows. The entire back of the camera is removable, and its outside face is shown at P. Through the centre of the back a horizontal shaft Q passes, which revolves in the bearing R.

Fig. 4 shows the inside of the camera. The inner end of the shaft is shown at Q, and the photographic plate S is mounted on this shaft. An ordinary adjustable lens shown at B (Fig. 2) was used to condense the light which came through the analyzer upon the slit.

The electrical tuning fork is shown at F (Fig. 1). Four storage cells were used to energize the motor, and greater uniformity in speed was obtained by placing a heavy iron-toothed gear-wheel as a fly-wheel on the motor shaft, as shown at N (Fig. 1). This wheel also served another purpose in offering a convenient and ready means of determining the proper speed of rotation for a given setting of the camera-slide. The wheel contained 56 teeth, and by simply holding on its periphery the edge of a card, with the motor

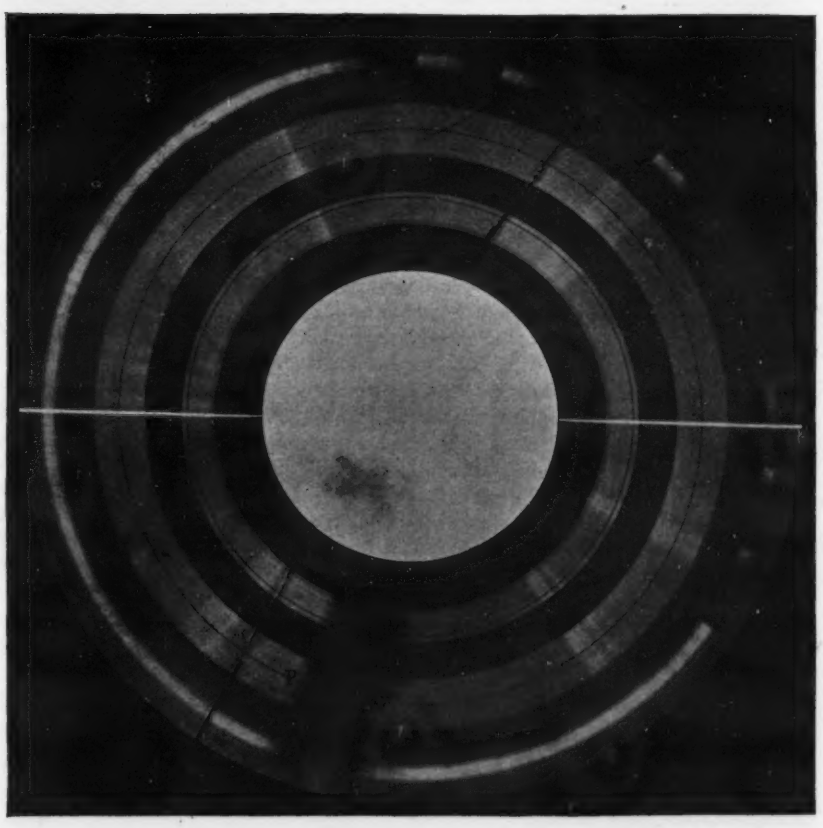


FIG. 7.—PROJECTILE CHRONOGRAPHIC RECORD.

running at an unknown speed, the corresponding note would be given out, and when this is compared with a tuning fork in the other hand of the observer, it indicated at once whether the speed of the motor should be increased or diminished.

Inasmuch as the variations of the intensity of the constant cur-

rent arc show so plainly in the negative, it may be of interest to show a record of an alternating-current arc taken with this camera. This is seen in Fig. 6, which shows that the arc goes completely out and appears again at regular intervals. It is noticeable that every other light spot is similar, but consecutive ones are different. The cause of this was a magnet held near the arc so that it was drawn out to the left when the current went one way, and to the right when it went the other.

The velocity of the projectile is obtained from the measurement of three quantities, the distance between screens, s the angular velocity of the plate, and θ the angle through which the plate revolves while the projectile passes between screens. This gives the expression for the velocity $v = \omega \frac{s}{\theta}$. The angle θ upon the plate can be measured with considerable accuracy. In an average case with a distance of 40 feet between screens the angle θ is 108°.0969 with a probable error from nine measurements of .0074 or an error of one part in 14,630. The angular velocity ω can with proper instruments be obtained with great accuracy.

In Fig. 7 is shown a chronograph negative which shows a record of the projectile at five-foot intervals from the muzzle to a distance of 45 feet. Table I. gives the relation between the several quantities, and the velocities found by considering the muzzle screen to be the first screen are shown in Table II.

TABLE I.

s	θ
5	13° 49′.29
10	27° 19′.29
15	40° 53′.79
20	54° 36′.00
25	68° 24′.83
30	82° 28′.25
40	110° 10′.46
45	123° 50′.88

TABLE II.

s	v
2.5	1599.4
5.0	1610.8
7.5	1621.7
10.0	1619.5
12.5	1615.6
15.0	1608.3
20.0	1605.3
22.5	1606.5

TABLE III.

s	v
2.5	1599.4
5.0	1637.5
7.5	1633.0
10.0	1626.8
12.5	1619.7
15.0	1610.5
20.0	1606.0
22.5	1607.3

The latter table is also exhibited graphically in Fig. 8, and shows that the velocity suddenly increases within a distance of six or eight feet from the muzzle of the gun, and beyond that point gradually diminishes. Every negative obtained shows an increase at the beginning of the trajectory. Since the velocity does increase for some distance from the muzzle, the average as measured from the muzzle screen must be less than if the point from which we measure were the maximum point. The velocities, calculated from the same readings as before, and taking the five-foot screen as the first instead of the muzzle screen, are given in Table III.

This table is represented graphically by the broken line labeled "mean velocity measured from the five-foot point."

The foregoing experiments described in detail justify one or two conclusions: This chronograph, as thus far developed, has clearly demonstrated its important field of usefulness for the accurate measurement of small intervals of time. The record made by a break in the current due to the passage of the projectile, is sharper and more defined than we had anticipated, and this permits of an accuracy in reading the record even beyond that attainable in measuring the intervals between screens on the proving ground. A future working instrument designed upon this fundamental principle is capable of endless modification, and an instrument properly designed would be as simple in its operation as any of the well-known chronographs now in use. The whole is manipulated by a single switch, which fires the gun and obtains the record.

The adaptability of this instrument for obtaining observations at any number of points of the same trajectory and the nearness which these points may have to each other, make it admirably suited to the study of the law of change of velocity near the muzzle of the gun, and also to the systematic study of the law of the resistance of the air to projectiles of various forms; a problem which, since the advent of the modern high-power gun with its realm of velocities unthought of in the classic experiments of Bashforth, is at present of paramount importance to the science of *exterior ballistics*.

The principal ballistic result obtained from these experiments may be said to be the locating of a maximum point in the velocity curve outside of the gun. This maximum point is, in the case of the gun and conditions of loading described, at six or seven feet from the muzzle of the gun—certainly more than five feet and less than ten—or about 25 calibres in front of the muzzle. The increase in velocity from the muzzle to the maximum point is large, more than 40 foot-seconds. The muzzle velocity being about 1,600 feet, this increase is about 2.5 per cent. of the whole.

The decrease in velocity beyond the maximum point is comparatively gradual, obeying the true law of the resistance of the air, so that the projectile must travel about a hundred feet before the velocity is reduced to that which it actually had at the muzzle.

This maximum point introduces an error in the present method of obtaining muzzle velocities, in which the velocity is measured at a distance of 100 to 200 feet and reduced back to the muzzle by formulas.

The direction of this error is shown in Fig. 9. Supposing that the

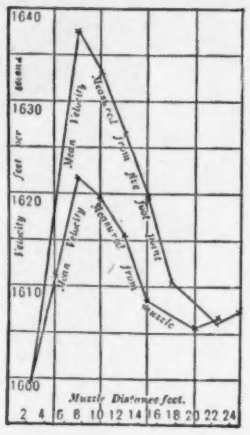


Fig. 8.

Fig. 9.

heavy line represents the true velocity curve, the part beyond the maximum point M would follow the law of the resistance of the air, and by reducing back by formula the law of air resistance is assumed to be continuous to the muzzle. This would extend the velocity curve corresponding to formula back to the maximum point, as indicated by the dotted lines, to A. The diagram measures velocities from a horizontal axis much below the axis represented, the increment of velocity above the actual muzzle velocity alone being represented. The diagram shows that the computed velocity for the muzzle is greater than the actual muzzle velocity by an amount $O\,A$, and also greater than the *maximum velocity actually attained by the projectile* at M by the amount $A\,B$.

The determination of the law of development of velocity inside the bore of a gun without the mutilation of a gun, would be a distinct advance in ballistics. Upon the data which such curves would furnish, rest not only the questions of gun construction, but also the ready study of new powders and their adaptability to existing ordnance. A few preliminary experiments were tried with a view of determining the value of this instrument for the measurement of velocities inside the bore, but any mention of them is withheld until further experiments can be made.

Cornelius Herz as an Inventor.

In a recent interview Dr. Cornelius Herz, at present a fugitive from French justice at Bournemouth, England, and who is described as worn with anxiety and pain and clearly dying, declared in broken utterances that he would leave a great invention to be patented and developed. The gist of the invention is an enormous improvement in telegraphy, by which more than 1,000 words can be transmitted by long submarine cables in the same time that 20 words can be sent now. The invention, the doctor claimed, would allow of cabling 50 words at a cost of five cents. He dwelt upon the influence that the invention would have upon the newspaper of the future, and said that he intended, in granting royalties, to reserve all rights as far as they applied to news. The invention, he said, would render submarine telephony and multiplex telephony feasible. Among those engaged in his laboratories in France on the experiments which have resulted in the invention he mentioned Edison's nephew.

Electrolytic Heating.

At the July meeting of the Société Internationale des Electriciens at Paris, M. Gosselin performed an experiment on electrolytic heating made many years ago. The apparatus consisted of a pail containing a solution of carbonate of soda, at the bottom of which was placed an electrode connected with the positive pole of an electrical souce. The other electrode in communication with the negative pole consisted of an iron or copper rod. When the rod touched the surface of the liquid, an arc was struck and the metal melted, falling to the bottom in the form of globules, the globules being hollow and filled with hydrogen. The difference of the potential utilized in the experiment was about 250 volts.

Selection of High-Speed Engines for Electric Lighting.

BY FRED. W. RICHART.

Having settled the question of size, and whether the engine is to be simple or compound, condensing or non-condensing, then comes the matter of choosing from among the many different makes the one that will most satisfactorily meet the requirements of the situation as to economy of steam consumption, regulation, reliability, freedom from accidents, and ease of repairs.

It is the purpose of this article to point out details of design and construction that are desirable and those to be avoided. It is hardly probable that any engine can be found on the market that shall embody all desirable features, and be free from all undesirable ones. Cases may arise where changes may be required of the builders, or the requirements may be such as to demand a distinct design.

The principal features affecting the economy of a steam engine are, steam distribution, clearance, and radiation. The conditions for most economical steam distribution in an engine running at uniform speed with variable load are constant admission, release, and compression, and variable cut-off. The majority of high-speed engines have but a single valve performing all the functions of admission, cut-off, release, and compression. For the engine to be automatic, the cut-off must be variable, but with the single valve it is impossible to vary the cut-off without varying the other functions, while it is desirable that all others should be constant. This may be nearly attained by the use of two valves, one driven by a fixed eccentric and controlling release and compression, and the other driven by a shifting eccentric, and controlling admission and cut-off.

With the combined admission and cut-off valve, the admission may be nearly but not quite constant with variable cut-off. A four-valve engine will secure the best steam distribution, and tends to reduce clearance, but it makes the engine more complicated and adds very materially to the cost.

In ordinary lighting plants, and especially small ones where but one engine is used, and that runs on light load much of the time, it is hardly worth while to pay the extra investment for the more complicated machine, for the best of engines cannot be economical on very light load. However, high cost of fuel may in many instances make it more economical to buy the more costly engine. Where the duty required of an engine will keep it pretty uniformly loaded at or near its capacity, it is unquestionably better to have a better steam distribution than one valve can give. In such a case care must be exercised that the more complicated valve gear is not so defective in design or unmechanical in construction as to render it in any degree more unreliable than the simple gear. It is certain that much more attention is now being given to questions of economy by builders of high-speed engines than was formerly. This has been brought about, largely, in order to hold their own against builders of Corliss engines, although the high-speed engine has much the advantage in point of space and ability to drive electrical machinery direct connected in small units.

The cylinders of compound engines should be so proportioned that the range of temperature is the same in each. By this means the amount of condensation and re-evaporation in either cylinder is not carried to excess.

In the majority of compound engines the valve of the low-pressure cylinder is driven by a fixed eccentric, which, however, may be adjusted to suit various conditions of load, but is fixed during any continuous run. Some builders make the cut-off automatic for both cylinders. Where the load is nearly uniform the first mentioned is entirely satisfactory, but where the load varies much and is light much of the time it will not pay to compound unless fuel is high, and then it should always be run condensing as well. It is the writer's opinion that an engine having the cut-off of both cylinders automatic, simple in construction, and driven by one shaft governor, might prove satisfactory even under quite variable loads. There are several such on the market. One thing must be carefully noted, and that is not to run a compound engine non-condensing on so light a load that the low-pressure cylinder becomes a drag, instead of doing its share of work.

The clearance in high-speed engines is very large when compared with slow and medium-speed engines. Engines may be found with a clearance of 12 or 14 per cent., but this is excessively large. This large clearance is due mainly to the large steam passages necessary for high-speed engines In engines with passages short and direct the above figure will not be reached by several per cent., perhaps may be as small as one half. Small clearances are economical, but it must not be carried so far as to make the ports so small as to wiredraw the steam, or cause too much back pressure.

Radiation from the cylinder and steam chest should be reduced to the least possible amount, by felt or some equally good non-conducting material, surrounded by a polished iron jacket, or wood lagging. A jacket of Russian sheet iron makes about the neatest appearance, and is easily kept clean. Steam jacketing, while unquestionably preventing the radiation of heat from the cylinder wall and may even add heat to it, is still a debated question among the best-informed engineers. It is probably of very doubtful utility in small units and especially so in high-speed engines. Moreover, such refinements are seldom faithfully carried out in practice by engineers in charge of the smaller-sized plants.

The importance of close regulation cannot be overestimated, for satisfactory and efficient service depends much upon it. To be quick and reliable in its action a governor should be simple in construction. A multitude of working parts and joints is to be avoided. Some makes of engines are supplied with governors, that while otherwise good, are slow in action because of the excessive amount of friction to be overcome in adjusting itself to a new load. Such a governor cannot regulate closely and is therefore very undesirable. The effective length of the weight arm of the governor should not be so short as to require excessive speed to bring it into action when starting up, nor should it be compelled to move through a very wide angle, in order to govern the engine. All joints and journals in the governor should fit closely but work easily. Ball bearings or knife-edge bearings are better than bored and turned journals. Another thing about governors, they must be kept clean if they work well. A little stiffness caused by grit, corrosion, being a little tight, and perhaps even stiff grease, will cause an engine to govern badly. A badly governing engine usually means "kicking" customers.

To be reliable, that is, to be able to do duty 365 days in the year, year in and year out, an engine must be substantial, correct in design, of first-class workmanship, and properly supplied with good lubricating devices. The most substantial engine is not necessarily the one with the most iron in it. The reciprocating parts must not be made so heavy that they are difficult to counterbalance. More iron in the bed than is really necessary is not so bad a fault. However, in any case it should be so distributed as to carry the stresses without distorting its shape. That is to say, the metal carrying the stresses between any two points should be in a straight line between those points, or if not, must be made much heavier than would otherwise be necessary, and parts carrying transverse stresses must be so designed and supported that they will bear a 50 per cent. overload without showing any sign of bending. The vibration in high-speed engines is so severe that every precaution must be taken that none of the parts can become loose or disjointed. Cheap construction is liable to cause these points to be overlooked, although they are of vastly greater importance than fine finish which merely attracts the eye. The use of check nuts on bolts should be supplemented by a spring cotter, as the check nut is sometimes jarred loose, and then both nuts work off. Bad accidents have resulted from neglect of this little precaution. Many bolts, especially on smaller-sized engines, are apt to be too small, not to do their work, but are apt to be twisted in two by men of little judgment of what a bolt can stand. One half inch in diameter is small enough for any bolt that carries any responsibility with it.

It is very common practice to screw the piston rod into the crosshead and rely on a check nut to hold it in place, but such check nuts will come loose, and to prevent accident in such cases a set screw should be screwed into the crosshead and against the piston rod to prevent its turning. Better practice than this is to have a long thread in the crosshead, making one end as a split nut to be clamped together by a bolt or machine screw to keep the rod from turning. It is better practice to screw and rivet the rod to the piston than to rely on a nut to hold it.

The cylinder head should have two holes drilled and tapped in which to screw handles by which to remove the head. The holes should be tapped clear through, then by screwing the handles in against the cylinder, the head may be removed without the use of a cold chisel. The use of machine screws for this purpose is objectionable as it involves the use of a wrench, and affords no convenient means of handling the head after it is loose.

The cylinder should always be provided with some means of releasing water that may happen to be in the steam pipe on starting up, or that may be carried over by priming. This is provided for in some engines by the ability of the valve to lift from its seat,

but with the piston type of valve other means must be provided. This is usually accomplished by using a spring valve similar to a safety valve, or by using a thin cast-iron renewable disc that will break before an injurious pressure is attained in the cylinder.

The question of whether the piston valve, the back-plate balanced valve, or the steam-balanced valve is the more desirable, is worthy of consideration, although if in competent hands they would probably give equally satisfactory service. The piston valve and some steam-balanced valves have the merit that there is no adjusting that can be done about them, and are therefore better fitted to put in the hands of incompetent men, than are the back-plate balanced valves, or the Giddings type of valve which requires some attention to keep the balancing pressure nicely adjusted. Some piston valves have no means of adjustment, while others are provided with self-adjusting packing. In a few years the former get to leaking appreciably, while the latter will run for a much longer time before requiring any attention. A good form of construction is to have removable bushings in the steam chest. When worn, a new valve and new bushings are put in by a few minutes' work, small expense, and the yet greater consideration in this class of work, that no time is lost with the engine. The advantage of the Giddings valve is that there are but two flat surfaces, the valve seat and valve, to keep in order, while with the back-plate balanced valves there are four surfaces to keep in working condition. Flat valves, properly cared for and kept nicely adjusted cannot be excelled for keeping steam-tight for long lengths of time without repairs being necessary.

The old style connecting rod, tapering from the middle toward both ends, is not the best shape to resist the stresses to which it is subjected when running at high speeds. The best modern practice is to make the thickness uniform and tapering the width from the crank end toward the crosshead, or if it is desired to have the rod of lighter weight, the metal is cut away to leave the cross-section like an I-beam. Rods having a rectangular cross-section are sometimes too thin, and will spring under load. It is well to watch this point. It makes but little difference whether the rod have strap, marine, or solid ends, so they are well made. Straps should be held on by two bolts with check nuts and spring cotter, and the gib and key only used for adjusting the box. Keys should be long enough to reach clear through the strap when the box is new, have a small hole drilled through the end, and a spring cotter put in to avoid all possibility of the key coming out, should the set screw come loose. Sometimes a long counter-sink is milled in the side of the key to receive the set screw. Should the set screw jar loose the key can come out only so far as the counter-sink admits.

Some builders have good success with built-up crank shafts, but a solid forged shaft is certainly more desirable in a centre-crank engine. In a centre-crank engine, the crank pin should be as large as the shaft, because if not it introduces a flexible place in the shaft and may cause it to spring and run hot. For the reason that it does not affect the stiffness of the shaft of a side crank engine, it is not necessary that crank pin should be as large as in the former case. However, ample surface is always desirable and it must not be made so small that the oil can be squeezed out in running. The main shaft of this class of engine should be much larger in size than is necessary in slow-speed engines, that the bearings may have ample wearing surface without making them too long, and that it may not spring when running. The best grades of centre-crank engines have the shaft almost one half the diameter of the cylinder, in the smaller sizes, and reducing somewhat in the larger sizes. This proportion is for simple engines.

The fly wheels should be thoroughly free from any flaws whatever. Possibly steel castings are much safer than cast iron, but it is very rarely that the fly wheel of a high speed engine explodes. The wheel should be heavy, both for steadiness of speed and to make a substantial job, and should be accurately balanced. A truer running wheel will be obtained by having the hub split, bored to exact size and clamped to the shaft by bolts through the hub, than by the usual method of keying.

The guides and crosshead should have ample wearing surface. Some builders make the length of the crosshead gib equal to the length of the stroke, and the width equal to one half the cylinder diameter; while this gives a larger surface than is necessary it is not a bad fault. The gibs or shoes should be made of bronze or lined with babbitt metal, and adjustment provided to take up the wear. Bored and V guides are objectionable on horizontal engines for the reason that the oil tends to flow to the centre or edge. This objection does not hold in upright engines, and in some styles of self-oiling engines where the oil supply is so abundant that the slide is well lubricated, no matter what the shape may be. The crosshead pin is sometimes flattened at the top and bottom so it will not wear out of round. Probably better practice is to make the pin removable and turn it around occasionally to distribute the wear over the whole surface.

The main bearings should be lined with the best quality of babbitt metal as also the crank pin boxes. At the factory it is usually hammered in, bored and scraped to fit, but it is usually impractical to hammer in and bore out a box where the engine is running, and the box should be so designed that this kind of repairing can be quickly and at the same time accurately done. Babbitt-lined boxes for the crank pin are preferable to brasses because this part is most liable to run dry and heat, and in case it does the babbitt will melt out without damaging the crank pin, while the brass, requiring a higher temperature to melt it, may damage the pin considerably.

The methods of lubrication and the devices used deserve the closest study. Uncertain methods of lubrication may totally unfit an otherwise good engine for electric lighting purposes. An engine for this work must always be able to make continuous runs of from 12 to 20 hours daily, and sometimes they are required to run several weeks without stopping. Every oil cup, receptacle, or device, should be so arranged that it may be filled while the engine is running. Where oil cups are used none but the very best should be allowed, and those should be large enough to hold sufficient oil for a considerable run. The cylinder lubricator is one of the most important, should be easy to fill, have the upper connection four feet long to make the feed positive, and have the sight glass large so the drops of oil cannot come in contact with and adhere to the sides. It is needless to say that the old-fashioned tallow cups are useless for this kind of work, being wasteful, and worse than that, you don't know when they are working, or when empty. An oil pump should supplement the cylinder lubricator to use in starting up, and in case of emergency. The crank pin is more difficult to properly lubricate than any other part. Wipe oilers do very well as long as the boxes are nicely fitted, but, nevertheless, they require careful watching. In some engines, in addition to the wipe oiler, the waste oil from the main bearings is caught in a groove in the disc and conveyed through holes to the crank pin. This is certainly a very great help. The enclosed types of self-oiling engines are usually very satisfactory, but in these some of the parts are a little more difficult to get at. There is also the satisfaction of knowing it can be left to itself for a considerable length of time if necessary.

Means of adjustment should be provided for all places where the wear demands it, but this is too frequently carried to excess, and in incompetent hands becomes a source of annoyance because they can't stop tinkering till they get the machine out of adjustment.

The engine should be designed with a view to getting at any part without disturbing many other parts. Times do come when repairs must be made, and made quick, and in such circumstances no one wants to spend unnecessary time in getting at the affected part.

A cast-iron sub-base looks better than a cap-stone, and especially so after it has become smeared with oil. Aside from this it has no particular advantage, except that it gives more weight to the engine proper. Most builders usually furnish them. In most cases their cost will be a little more than the cost of a cap-stone.

The general appearance of an engine may be considered, but not till all questions of utility, economy, and safety have been fully decided. Appearance is pleasing, but it does not pay dividends.

Electric Traction in Egypt.

Electric street railways are promised for Cairo next year, the concessionaires being Belgians; and Alexandria is expected soon to follow suit. There are several bidders for a concession for an electric tram line from Cairo to the Pyramids, a distance of 10 miles, to accommodate the enormous number of winter visitors to the capital. The Egyptian ministry recently had from a Frenchman a serious application for permission to build a "funicular" railway to the top of the great pyramid. The request was not considered.

Effect of Different Sizes of Carbons.

Prof. Blondel, of Paris, in measuring the total spherical intensity of arc lamps, found that it was nearly trebled by diminishing the carbons from 21 and 13 mm to 14 and 8 mm diameter, the 13 and 8 presumably referring to the negative carbon.

Electrodynamic Machinery.—XLIII.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

299. As in the case of generators, the *efficiency* of the electric motor is the ratio of the output to the intake; that is,

$$\text{Efficiency} = \frac{\text{Output}}{\text{Intake}}.$$

Since the output must be equal to the intake after subtracting the loss taking place in the machine, this may be expressed as follows:

$$\text{Efficiency} = \frac{\text{Intake} - \text{Losses}}{\text{Intake}}.$$

300. The losses which occur in a motor are of the same nature as those already pointed out in Sec. 201, in connection with a generator. This is evident from the fact that a motor is but a generator in reversed action; so that any machine of this nature is capable of being operated, either as a generator or as a motor, according as the driving power is applied to it mechanically or electrically. There is this difference between the two cases, however, that a very small dynamo-electric machine may be capable of acting as a motor, while it is not capable of acting as a dynamo, owing to the fact that it is not able, unaided, to excite its own field magnets, its residual magnetism being insufficient for this purpose. On this account, motors can be constructed of much smaller sizes than self-exciting; *i. e.*, dynamo, generators.

301. If the losses which occur in a dynamo-electric machine, acting as a generator, have been determined, we can, therefore, closely estimate what these losses will be when the machine is operated as a motor, and, consequently, the efficiency of the machine as a motor can be arrived at.

302. There is this difference between a dynamo and motor as regards the output; *viz.*, in the dynamo, the losses are supplied by the driving source; in the motor these losses are supplied electrically from the circuit; but the output of a dynamo-electric machine is almost invariably determined by the electrical activity in its armature circuit; that is to say, the armature is limited to a certain number of amperes received or delivered at a certain number of volts pressure, so that since this load is the output, when the machine is a generator, and the intake, when the machine is a motor, it is evident that after the losses as a motor have been subtracted, the mechanical output will be less than the electrical output which the machine produces as a generator.

303. For example, let us suppose that a certain machine, acting as a series-wound generator, is capable of delivering 10 amperes at a pressure of 100 volts, so that its output is 1 KW. Let us also suppose that when acting as a generator, a loss of 250 watts occurs, in friction, hysteresis, eddy currents and I^2R losses, both in the armature and in the field; then the mechanical intake of the machine will be 1,250 watts, and its commercial efficiency, $\frac{1000}{1250} = 0.8$ or 80 per cent. When, however, the machine is operated as a motor, the armature is limited to the same current strength of 10 amperes, and the pressure at the machine terminals can only be slightly in excess of the 100 volts previously delivered. Let us suppose that this is 110 volts. Then the intake of the machine will be 1,100 watts. Assuming the same losses as before; namely, 250 watts, the output would be only 850 watts, and the efficiency, therefore, $\frac{850}{1100} = 0.772$, or about 2¾ per cent. less than in the preceding case. It is clear, therefore, that while the output of the machine was 1,000 watts when acting as a generator, it was limited to 850 watts when acting as a motor, assuming that the same limiting armature temperature and same liability to sparking were accepted in each case.

304. The difference above pointed out between the output of a machine acting as a generator and as a motor, diminishes with an increase in the size of the machine. Thus, while a 1-KW generator is usually only a 1-HP motor (or say 750 watts), a generator of 200 KW would probably be a motor of 185 KW; so that in the case of very large machines, the difference between the outputs in the two cases would be practically negligible.

305. The curve in the accompanying Fig. 204, approximately represents the efficiency which may be expected at full load from motors of varying capacity up to 200 KW. This curve has been plotted from a number of actual observations with machines constructed in the United States.

306. It is to be remembered therefore that the full-load efficiency of a motor is not always the criterion upon which its suitability for performing economically a given service is to be determined. It not infrequently happens that the character of the work which a motor has to perform is necessarily exceedingly variable, so that the average load might not equal or may even be less, than half the full load of the machine. Under such conditions, the *average efficiency* is of more importance than the *full-load efficiency*. Were the efficiency curve of all motors in relation to their load of the same general outline, the average efficiency would be approximately the same in all motors having the same full-load efficiency. As a matter of fact, however, the efficiency curves of different machines may be very different. Thus one machine may have its maximum efficiency at half load, and behave at full load in regard to its efficiency as though it were actually overloaded, while another machine, with the same full-load efficiency, may show a lower efficiency at half load. Obviously the first machine would be preferred for variable work, other things being equal.

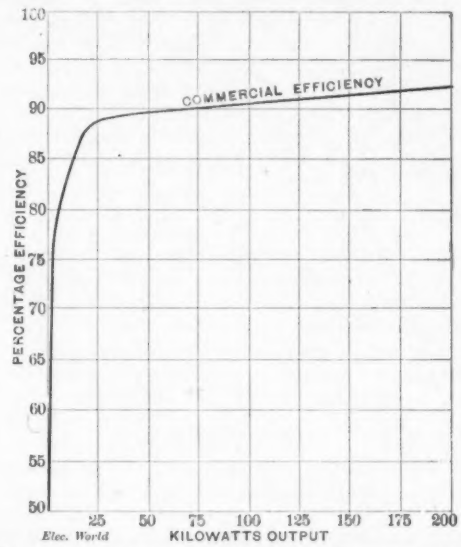


FIG. 204.—COMMERCIAL EFFICIENCY CURVE OF MOTORS.

307. Similar considerations apply to electric generators. The full-load efficiency is not in every case the ultimate criterion of economical delivery of work, but it generally happens that generators are installed in such a manner, and under such conditions, that a nearer approach to their full load is attained, so that ordinarily the shape of the efficiency curve of a generator is not of such great importance as that of a motor.

Fig. 205 represents the efficiency curves of two motors, each having a full-load efficiency of 78 per cent. One of these machines has an efficiency at about two thirds load of 84 per cent., but at overloads is inefficient, while the other becomes more efficient at overloads.

308. In order to produce a motor of given full-load efficiency with comparatively small loss at moderate loads, and, therefore, a comparatively heavy loss at heavy loads, we may employ a slow-speed motor, or a motor which shall generate the necessary C. E. M. F. at a comparatively low speed. Such a machine will probably have a small loss in mechanical friction, because of its lower speed of revolution. It will, similarly, have probably a small loss in hysteresis and eddy currents for the same reason, but a slow speed motor will probably have a greater number of armature turns in order to compensate for the smaller rate of revolution, and the I^2R loss in the armature is, therefore, likely to be greater at full load. In such a machine, the loss at full load is principally due to I^2R; and, since this loss decreases rapidly with I, it will evidently have a small loss at moderate loads.

309. The speed at which a motor will run in performing a given amount of work varies considerably with different types of motors. For example, of two motors of 20 kw capacity, one may run at 400 revolutions per minute, and the other at 1,000 revolutions per minute. It is evident that the first machine will have two and a half times the full-load torque of the second. The lower speed is, however, generally speaking, only to be obtained at the expense of additional copper and iron; that is to say, the cost of material in a slow-speed machine will probably be greater than the cost of material in a high-speed machine of the same output. It becomes, therefore, a question as to the relative commercial advantage of slow-speed versus high-speed in a motor.

310. Motors are generally installed to drive machinery either by belts or gears, and the belt speed or the gear speed of machinery is in practice a comparatively fixed quantity. If, therefore, the speed of the motor be greater than the speed of the main driving wheel of the machines with which the motor is connected, intermediate

reducing gear or countershafting has to be installed. This adds to the expense of the installation, not only in first cost but also in maintenance, lubrication, and the continuous loss of power it introduces through friction. The result is, that up to a certain point, slow-speed motors are economically preferable, and the tendency of recent years has been toward the production of slower speed dynamo machinery. In comparing, therefore, the prices of two motors of equal output, the speed at which they run has to be taken into account, as well as the efficiency at which they will operate. It is to be remembered that any means in the design which enable a motor to supply its output at a lower speed, are equivalent

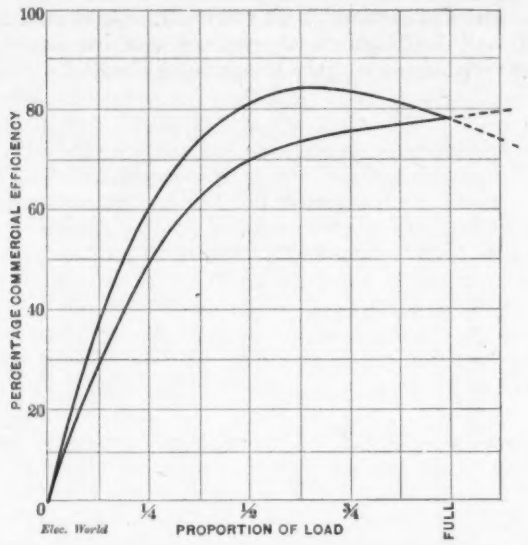


Fig. 205.—Efficiency Curves of Two Different Motors Having Same Full Load Efficiency.

to means which will enable a motor of the same speed to supply a greater output.

311. The weight of a motor is a matter of considerable importance in cases of *locomotors; i. e.*, of traveling motors, as in the case of electric locomotives, street car motors or launch motors, but in the case of stationary motors, their weight is of less consequence, since after freight has been once paid for their shipment, no extra expense is entailed by reason of their increased mass when in operation. Indeed, weight is often a desirable quality for a motor to possess in order to ensure steadiness of driving, although undue weight in the armature is apt to produce frictional loss, and diminished efficiency.

312. In comparing the relative weights of motors, two criteria may be established; namely: (1) In regard to torque, and (2) in regard to activity. In some cases, the work required from the motor is such that the pull or torque which must be given in reference to its weight is the main consideration, while in other cases it is not the torque, but the output or activity per pound of weight, which must be considered.

313. The torque per pound, in the case of street car motors, where lightness is an important factor, has been increased to 133,000 centimetre-dynes per-ampere, per-kilogramme of weight; or, 0.0045 pound-foot per-ampere per-pound of total motor weight, exclusive of gears, so that a 500-volt street car motor, weighing 223 pounds, and supplied with one ampere of current, would exert a torque of one pound-foot. In stationary motors, the torque is usually only 0.001 to 0.0015 pound-foot per-ampere per-pound of weight, or about four times less than with street car motors. This is owing to the fact that cast iron is more largely employed in stationary motors, owing to its lesser cost.

The output per pound of weight in motors varies from five watts per pound to 15 watts per pound, according to the size and speed of the motor.

(To be continued.)

Laboratory of Houston and Kennelly, Philadelphia.

Single vs. Double-Motor Cars.

To the Editor of The Electrical World:

Sir:—On one of the street railways of a city in Connecticut, there are three motor cars equipped by the same company and alike in every respect except that one has a single-motor outfit and the others have double motors, the motors of all three, however, being identical in type and power. The road passes over several hills, and it has been noted that if the double-motor car goes up the grade of one of these hills in advance of the single-motor car, and both stop, the latter being a car-length in rear of the former, then if both start about the same time, and each with the controllers full over, the single-motor car will always overtake the other in three or four car-lengths and, if allowed, push it along. I should like to know why this occurs, as it would naturally appear that the car with two motors would be able to get out of the way of the single motor car.

Inquirer.

New Haven, Conn.

The Monocyclic System.

To the Editor of the Electrical World:

Sir:—In the Digest of your esteemed paper, of July 20, I read an abstract of an article in the German paper, *Elektrotechnische Zeitschrift*, stating that the monocyclic system has been anticipated in the installation of Dresden, Germany.

The description of the Dresden installation represents it as a three-phase system, in which all the lights are connected in one branch only, and the voltage of this branch maintained constant. Motors are operated from all three lines.

I only need to refer you to my note in the July 27 issue of your paper, on the monocyclic system, to show that the Dresden installation has no similarity whatever with the monocyclic system, but is an ordinary three-phase system, operating three-phase motors, while the monocyclic system contains a standard single alternator in combination with a supplementary winding for the supply of the magnetizing current to single-phase motors. Thus, relative size and phase relation and the flow of current are entirely different in the monocyclic system from that in the Dresden installation.

Schenectady, N. Y. Chas. P. Steinmetz.

Interior Wiring Precautions.

To the Editor of The Electrical World:

Sir:—Several cases where electric light wires have been run in iron tubing with a tube for each wire have come to my attention, and it may be that a timely mention of this error will save some wiring contractors from getting into trouble by inadvertently following improper wiring specifications. In one case a large stone church was wired throughout for electric lights at 52 volts alternating current, the two wires being placed in separate iron pipes. When the current was turned on the inductive drop was so great that there was not enough electromotive force at the lamps to read the voltmeter by, and it was necessary to tear out four fifths of the iron pipe and insert condensers to overcome the effect of that part of the pipe which could not be removed, owing to its being embedded in stone walls. A new $100,000 building in Cincinnati is wired in the same manner. In this case the institution will have its own dynamo and use continuous current; but it certainly is a mistake to so do the work that only one kind of current can be used. Besides the prohibitive objection of induction with alternating currents, the practice of using two separate pipes is radically wrong, and defeats the only purpose for which iron pipe is to be used, namely, to make fire-proof installation. It is unsafe. Suppose one wire becomes grounded in its pipe, if the wire in the other pipe becomes grounded also, wherever the two pipes come in contact the current will flow between them and probably start an arc which may set fire to the building. But, if both wires are in the same pipe any short circuit will be confined to the tube, which ought to be sufficiently thick to be fire-proof.

Wm. Mayo Venable.

Cincinnati, O.

Prevention of Electrolysis.

To the Editor of The Electrical World:

Sir:—As a remedy for injury to water and gas mains by electrolysis due to trolley return currents, I would suggest the use of glass or terra cotta pipes, which are both good non-conductors of electricity and have several advantages over iron. The use of glass pipes would greatly reduce the friction caused by the rough and rusty inner surface that exists in all iron pipes, and by the reduction of friction an increased pressure of both gas and water would occur at the point of delivery; the numerous leaks existing in all underground iron pipes caused by small rust holes would also be done away with, and the opportunities for street explosions caused by gas from such leaks accumulating in underground conduits, reduced to a minimum if not entirely done away with. I understand that a new process for making glass water pipes has been discovered.

J. H. Robinson.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

BY CARL HERING

Note.—Typewritten copies of any of the articles referred to in the Digest, will be furnished at the rate of 5 cents per 100 woods for English matter, and 8 cents per 100 words for matter in foreign languages; translations at the rate of 40 cents per 100 words. Copies of any of the journals may be ordered; address Branch Office, ELECTRICAL WORLD, No. 927 Chestnut Street, Philadelphia, Pa.

DYNAMOS, MOTORS AND TRANSFORMERS.

Designing of Transformers.—An article by Mr. Adams is begun in the Lond. "Elec. Rev.," July 19; it is written in an easily understood style containing only comparatively simple and practical formulas; he limits himself to closed magnetic circuit transformers to be connected in parallel on constant potential mains, as this is the class of transformers most frequently used in practice; regarding the open circuit transformers he states that they form a very small class, probably destined to become smaller. The design of the transformer depends not only on electrical and magnetic quantities but also on commercial facts, and is in a great measure dependent on the judgment of the designer; data based on mathematical investigation and physical experiments are not very plentiful and that which exists must frequently be modified. A large transformer usually has more copper in proportion than a small one and is therefore relatively more expensive; the best proportion of iron to copper must be considered; the quantity of copper used should be reduced to a minimum for commercial reasons; small transformers are not ideally perfect as regards efficiency but are less costly than they would be if they were perfect in this respect; wrought-iron wire and strips have given place almost universally to sheet-iron stampings; an important point is accessibility for repairs, to which feature he believes not sufficient prominence has been given; it is of great importance to keep down the current on open secondary circuit and this involves working at a low induction, small iron losses, a good quality of iron, a closed magnetic circuit and a large number of primary turns; to illustrate this principle he works out the data for a 10-kw Mordey transformer, to transform from 2,000 to 100 volts at a frequency of 100. The sheet iron is 0.014 inches thick, insulated with thin paper; the stampings are so made that the rectangular portion which is stamped out from the centre of the rectangle is used for building up the core, thus wasting very little of the iron, but he questions whether other important points are not sacrificed thereby; he assumes the losses in the copper to be 1.4 per cent. and deduces the primary and secondary currents; he then calculates the total loss in the copper and from this, the current density for which he assumes a maximum of 900 amperes, from which he obtains the length and the cross-section of the primary wire and therefore its resistance; he then determines the dimensions of the iron core, first, however, deciding upon the number of turns; in practice the number of secondary turns in such a transformer varies from 12 to 50, 24 giving fairly good results; with 30 or 50 turns it will have a great efficiency but the cost of the copper will be considerable.

LIGHTS AND LIGHTING.

Arc Light Phenomenon.—Mr. Pochin, in the Lond. "Elec.," July 19, refers to the article abstracted in the Digest, July 27, and states that silvered globes are not at all necessary to produce this effect as he noticed several years ago that the same result was produced by egg-shaped opalescent globes which gave such well-defined foci as to char wood in a few seconds and burn off pieces one inch long of the negative carbon; he obviated the difficulty by increasing the size of the negative carbon.

Arc Lights.—The "Zeit. f. Beleucht.," July 15, contains an article by Dr. Weber in which he points out the advantages of the arc light over other forms of illumination and states that there is a tendency for arc lights to approach more and more toward typical, fundamental forms; he proceeds to describe and illustrate a number of these types, all of which are lamps of German manufacture.

POWER AND HEAT.

Niagara Power Plant.—In the Digest, July 13, a communication from Prof. Rowland reflecting on Prof. Forbes was abstracted; Lond. "Lightning," July 11, contains a brief reply from the latter. He states that that letter requires refutation on two points, first, that Prof. Rowland had anything to do with the plans adopted for Niagara, and secondly that the extract from one of his (Forbes's) confidential reports is the specification which he sent out to manufacturers to bid on. He states that Prof. Rowland at first considered the Tesla motor to be of no use, but that seven months of instruction reversed this decision; the report of Prof. Rowland was not shown to Prof. Forbes until the latter had completed all his plans and decided on the designs of the dynamo; Rowland's report did nothing except to recommend the dynamo proposed by a certain firm which was totally unsuitable; his law suit showed that he (Rowland) had nothing to do with the plans. The quotation in that letter is not the specification which Forbes sent to the manufacturers and was not the final one; "it is absurd to say I opposed what we have done; as the consulting engineer, I originated it and carried it all through"; what was quoted as his specification was a suggestion made when a separate fly wheel was thought necessary and his suggestion was guarded by an "if"; he wishes it to be known that Prof. Rowland's misconceptions are largely due to the fact that "we did not think it necessary or advisable to inform him of what we were doing."

TRACTION.

Conductors for Electric Railways.—The "Elec. Ry. Gaz.," July 27, abstracts at some length a recent lecture by Mr. Burch on "Economy of Conductors Used in the Transmission of Currents for Electric Ralways"; the original is a long mathematical treatment and goes into detail. He demonstrates, mathematically, Kelvin's law regarding the most economical cross-section, and deduces a formula which shows that this cross-section is independent of the length of the circuit and the voltage. To illustrate the application he assumed that the current delivered at the receiving end is constant, a rate of interest and depreciation of 6 per cent., the cost of energy at power house $87.60 per hp per annum, and the cost of conductor 13 cts. per pound, under which conditions he found that 6,900 circular mils per ampere must be provided in order to work out the greatest economy. He called attention to the fact that the equation expressing the Kelvin law is not applicable to power transmission owing to extreme fluctuations, and he believes that the lack of this knowledge has led to some absurd engineering, especially to low potential transmissions over very great distances. For a fixed voltage at the generator end the current transmitted and the resistance of the line are dependent on the voltage and the voltage depends on the resistance of the line, if the latter is high the current used by the motors will actually be greater than if the resistance of the line were less. Having determined the economical cross-section of copper and having the length given, the resistance is readily determined; often the economical resistance of the track is so much lower than it need be, that the size of the copper feeders may be made very small; he calls attention to the importance of the distribution, which, if not to the best advantage, represents a waste of money and power. He describes a system which has been in use in Minneapolis and St. Paul for nearly two years, an account of which has not yet been published, and he believes it is not in use elsewhere; he calls it a "jumper" system, and it consists in connecting the sections to each other through No. 12 copper wire fuses in such a way that the load of the feeders and sections is equalized, the feeders therefore helping each other; when the trolleys on different sections are "jumpered" the fuse is simply connected around the circuit-breaker; parallel feeders feeding different sections are jumpered with fuses placed at the feeder diverge, or as far from the power house as possible; the 65 feeder sections and the three power houses of Minneapolis and St. Paul are thus connected and pull together; in case a wire breaks the jumpers blow and the section is clear. The advantages of this system are: It avoids the great fluctuation of load on any one feeder, to illustrate which he gives a diagram (which is reproduced) of the current in an actual case before and after the feeders and section were jumpered, the difference being enormous; the line voltage consequently changes slowly; each feeder being in parallel with the others the current is much more economically distributed; the total current at the power house varies less since power houses thus work together and divide the fluctuations; fewer reserve units are therefore required and the machinery can be worked more nearly up to its full capacity; the trouble at the switchboard is greatly decreased and there are fewer blowings of circuit-breakers; the power houses being joined, there is much less drop; the feeder current can then be measured with a Weston ammeter without trouble.

The Trolley in Competition with Railways.—The "Eng. Mag." for August contains an article by Mr. Deming in which he gives a good account of the state of affairs in Connecticut. He summarizes the past and the present legislation in that State regarding electric roads and the rival steam roads. Among the data which he gives, the following abstracts may be of interest: In January, 1893, there were approximately 147 miles of single track street railways in that State, of which 81 were operated by horse-power and 66 by electricity; there are now 289.7 miles of which all but about five miles are electrically equipped; there was a 97 per cent. increase in mileage within a period of 29 months; in January, 1893, there were 22 corporations and now there are not more than 24, notwithstanding the great increase in mileage; he believes the increase in not a few

cases has been too speculative ; there are 381 miles of projected trolley roads. He discusses the effect of trolley roads in that State as parallels of the steam lines and gives figures showing the effect on the steam roads in the loss of the numbers of passengers carried; the loss to the Consolidated Company would be represented by 339,744 passengers in a year and this represents only about $32,461 which is partly offset by the withdrawal of a train and the probable additional business fed to the steam roads by lateral trolleys; taking it as it stands it represents one eighth per cent. of the gross receipts; the trolleys now paralleling steam roads in the State amount to 91 miles. "The most sagacious opinion inclines to the belief that the immediate competition between proximate stations will hardly grow into serious rivalry between intermediate ones, and that the trolley as a parallel and competitor will presently be succeeded and offset by the trolley as a lateral and feeder." Public opinion in Connecticut now tends strongly toward the feeling that electricity paying fairly for its privileges and buying its own right of way, has a right to work out its own future whether as a parallel or not.

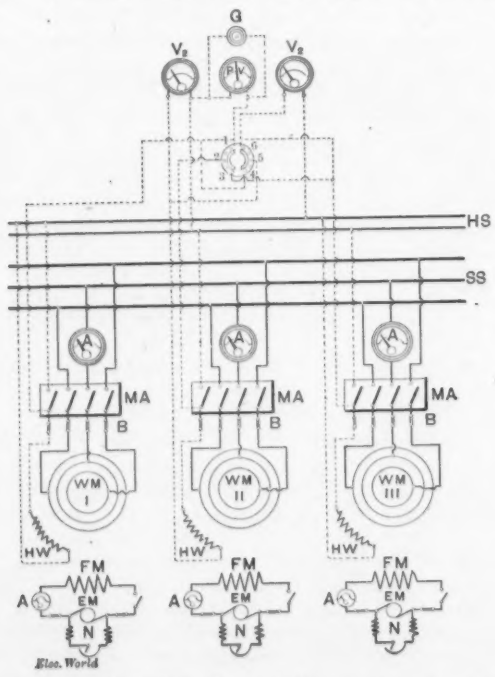
Relative Economy of Electricity and Cable.—In a recent interview, of which a brief abstract is published in the "Elec. Eng.," July 31, Mr. Bowen, superintendent of the Street Railway Company, of Chicago, made some relative statements regarding electricity and the cable. He states that electricity is a complete success under certain conditions but there is no probability that the cable will ever be replaced with electric cars, at least as long as the electric system remains what it is at present. When there is sufficient traffic for 12 cars to the mile of double track, the cable becomes the cheapest form and electricity cannot compete with it; when the traffic is not sufficient for more than four cars to the mile of double track, horses become the cheapest form ; between these two extremes, electricity is the most desirable. The barn space for a street car is 300 square feet; the space occupied by horses for that car is 800 square feet ; the change to electricity gives railways two thirds more barn room. Editorially, the journal states that Mr. McCulloch, of St. Louis, remarked that when a road earns more than $50 per day per mile of single track, it is more economical to operate it by electricity, but when the amount reaches $100 per day, the cable is cheaper.

Projected Interurban Lines.—The "St. Ry. Rev.," July 15, publishes a table, giving the mileage, classified according to States, of 190 electric railway companies which have been projected, some of whose lines are in process of construction, and others will be begun this season; the total mileage is 3,457; the longest of these lines are from Bellefontaine to Lima, O., 100 miles; from New York to Philadelphia, 80 miles; from Jacksonville to Tampa Bay, Fla., 50 miles; from Merced to Yosemite Valley, Cal., 62 miles; from Detroit to Toledo, 52 miles; from Cincinnati to Dayton, 65 miles; from Marion to Pt. Clinton, O., 75 miles, and from La Crosse to Neillsville, Wis., 80 miles. Ohio leads with 31 roads, Pennsylvania has 26, New York 23, Indiana 15, Massachusetts 14, California 6, and New Jersey 5.

Electric Brake.—The "Elec. Ry. Gaz.," July 20, gives an illustrated abstract of a description of a braking mechanism recently patented by Mr. Porter (assigned to the General Electric Co.); the braking apparatus is designed to be operated by the current from the motors when acting as generators; the controller consists of three cylinders, one being the usual controlling cylinder, another a brake cylinder, and the third a receiving cylinder or switch.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

System for Connecting Alternators in Parallel.—In the "Elek. Zeit.," July 11, Mr. Vietze describes the following system: In the usual system when an alternator is to be coupled in parallel with another, it had to be first regulated so as to give the required voltage and then had to be coupled with regard to the phases; a simultaneous measurement of phase and voltage was possible only by using a number of specially constructed apparatus; the present system, which in the accompanying illustration is adapted to a three-wire circuit, enables one to measure simultaneously both the phase and the voltage of the machine to be coupled, with the aid of simple apparatus. W M represent the machines; let I be supposed to be running; by means of a small switch, which is easily coupled with the main switch, the auxiliary winding H W is connected with the auxiliary wires H S, the voltmeter V_1 indicating the voltage of the machine which is running; if now the machine II is to be coupled it is only necessary to move the circular switch to contacts 2 and 5 by means of which the voltmeter V_2 is connected to the auxiliary winding H W of the second machine and the phase voltmeter P V is connected, as is readily seen in the figure; one is thereby enabled to read and compare simultaneously the voltage and the phase ; when these are properly adjusted the main switch is closed, which also connects the auxiliary winding of the second machine with the auxiliary wires H S.



Lighting Gedney's Channel.—The "Elec. Eng'ing," July 31, contains a brief, illustrated description of the alternating-current plant which has been installed in this channel in the New York Harbor. Alternating currents of 1,000 volts are used; the station is at Sandy Hook, and there are two underground wires at the landing place of the Gedney cable; it appears that one of the wires is lead, covered with rubber insulation, and the other is bare; the Southwest Spit cable consists of one conductor of seven No. 18 wires and two armors of steel wire; the weight per statute mile is 19,113 pounds; the cable in the Gedney Channel also has one conductor of seven No. 18 wires and is armored with a hard-drawn copper wire, the insulation being well-seasoned gutta percha of a resistance not less than 300 megohms per mile. The current is transformed in a small transformer of 600 watts placed inside the head of the wooden buoys; the transformers are mounted in strong, water-tight cases, with heavy oil as an additional insulation; the lamps are at the top of the buoy, which is a pole 70 feet long anchored by a heavy weight; the lamps are covered by bell glass globes and are of 100 cp; the filament is spiral; the lamp takes from 3.5 to 4 amperes.

WIRES, WIRING AND CONDUITS.

Sulphur from Flexible Cords.—Lond. "Lightning," July 11, cites a peculiar case in which it was found that the sulphur contained in the vulcanized rubber in flexible cords used in the show window of a jewelry store, was set free and discolored gold and other objects; when pure rubber insulated cords were substituted the trouble ceased at once.

Concentric Leads.—The paper of Mr. Grosselin, abstracted in the Digest, July 13, is published in full in "Bul. Soc. Int. des Elec." for June.

Rules and Regulations.—Those proposed in Germany are discussed in a long communication by Mr. Goerz in the "Elek. Zeit.," July 4.

Conductor Materials.—Dr. Perrine's article is continued in "Elec. Eng'ing" for July ; he discusses alloys for conductors which are intended to absorb energy, that is, to be used for resistances, in which high specific resistance and low temperature coefficient are the desired features. The article appears to contain nothing new but is a very good compilation of useful data and includes references of the original sources ; it contains a number of tables of data regarding the more important alloys. He states that it has been shown by tests made at the Cavendish laboratory, that platinum silver may be relied upon for the construction of standards of great accuracy and permanence ; the only material which can compete with it is the patent nickle made in Germany of which reliable tests indicate that it remains absolutely constant under various changes of temperature. Arsenic copper, although having valuable properties, is unfortunately extremely brittle and very difficult to work ; it also is said to give off arsenic fumes at high temperatures. Favorable remarks are made concerning manganine which is composed of copper, nickle and ferro-manganese in varying proportions ; if a completed coil of this material is annealed at a temperature of 140 degrees C. for five hours no difficulty will be experienced from any aging change nor from repeated heating ; it has been shown that if proper care is taken to have it of constant chemical constitution it may be depended on for constant electrical properties ; another advantage is its feeble thermoelectric power when connected with copper as it almost always is in standard coils ; it is not above one or two micro-volts per degree Centigrade.

ELECTRO-CHEMISTRY AND BATTERIES.

Gas Accumulators.—The Lond. "Elec. Eng.," July 19, abstracts a paper from "Comptes Rendus," by Messrs. Caillett, Collardeau and Berthelot, on "Condensation of Electrolytic Gas." Such condensation takes place in porous substances, especially in metals of the platinum group ; spongy platinum in silk bags in sulphuric acid was used for both anode and cathode and the current passed until the platinum was presumably saturated, after which they were connected ; a much more powerful and persistent current was obtained than with the same weight of platinum and the operation of the current was greatly increased by pressure ; under atmospheric pressure the discharge lasts about ten

seconds and the E. M. F. falls continuously from 1.8 volts to 0 ; under gradually increasing pressure there are three periods, first a very rapid fall in the current which afterward rises slightly, and this is followed by a period of constant intensity which increases slightly with the pressure, the E. M. F. being about one volt, and finally there is a period of fall less rapid than the first. The capacity of the accumulator formed by the spongy platinum is 56 ampere-hours per kg under a pressure of 580 atmospheres, and the intensity of the current may easily reach 100 amperes per kg ; for the best results about three times as much platinum should be used for the negative as for the positive pole ; the yield (presumably meaning the efficiency) is 95 and even 98 per cent. providing the charge is not pushed to its limit and that the discharge begins immediately after charging. Palladium in a spongy condition gives much better results than any metal in the platinum group and even under atmospheric pressure is equal to platinum under a pressure of 20 to 30 atmospheres ; the behavior is similar to that of platinum but the capacity is three or four times as great and at 600 atmospheres may reach 176 ampere-hours per kg ; gold behaves like platinum ; palladium and similar metals form definite compounds with oxygen and hydrogen, the formation being influenced by pressure.

ELECTRO-PHYSICS AND MAGNETISM.

Arc Light and the Sun.—The "Cosmopolitan" for July contains short articles by Prof. Dolbear which is reprinted in "Elec. Eng'ing" for July. The surface of the sun radiates 10,000 hp per sq. ft. of its surface; the earth receives only ⅓ hp per sq. ft., of which about ⅓ is absorbed in the atmosphere, leaving about 0.25 hp received at the surface of the earth. A good electric arc requires 0.6 hp; the temperature of the crater is 6,300 degrees F. and its area about 0.1 in. square; a stronger current does not make this crater brighter or hotter but merely makes it larger. An arc having a crater 1 sq. ft. in area would radiate 8,640 hp which is nearly the observed amount from the sun; if the crater is taken to be a trifle smaller than 0.1 in. sq., say 1-12 of an inch square, then the resulting figure per square foot would be 12,441 hp, which is somewhat greater than that from the sun. From these facts it seems clear that the temperature of the sun does not need to exceed that in an electric arc, or 6,300 degrees, in order to shine as brilliantly and radiate the observed amount of energy.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Influence Machines—The Lond. "Elec.," July 19, contains three illustrated articles on influence machines; one is a translation of an article by Prof. Holtz from the "Wied. Ann.," No. 1, on "Theory of the Influence Machine with Oppositely Rotating Discs"; the other an original article by Mr. Wimshurst on "Observations on the Holtz Theory of Influence Machines with Oppositely Rotating Discs"; the third a translation of an article from the "Ann. de Chemie et de Phys.," May, by Mr. Shaffers on "The Theory of the Wimshurst Machine"; there is also an editorial discussion of the papers.

Prof. Holtz in his article offers a complete theory of those machines and describes and illustrates the various forms in which they may be constructed. The fundamental principle of excitation he explains as follows: "Let two endless strips of an insulating substance continuously pass, the one to the right, and the other to the left. Let a comb be placed in front and at the back, the points being directed toward the strips. Let the combs be connected with each other, so that the connection may be easily broken somewhere. Let a negatively electrified body be placed momentarily opposite one of the combs behind the strip. The influence effect of the electrified body causes the two combined electricities of the face of the front strip to be separated. The similar negative electricity flows into the comb, while the positive proceeds with the strip. Through the influence of the latter change the electricities of the back strip are separated, the similar positive electricity flowing into the comb, and the negative passing on with the strip. Since, therefore, negative electricity arrives opposite the comb *a*, it looks as if the electrified body was no longer necessary for the continuance of the process. But this is only conditionally true. Each strip charges the other, but not necessarily to a greater density, and eventually to a less density than it was charged itself. If each new charge is less dense, the electromotive activity must soon be lost after the exciter is removed. The induced charge will only support itself when it is denser, and then it will not only support but increase itself, and that will continue until the losses, which increase with an increasing density of charge, do not permit a further intensification. On introducing a gap into the connection of the combs, the displacement of electricity, and hence also the charging of the strips, is impeded. If the electromotive activity was kept up before, it may now be lost after introducing the gap. In any case this will happen on continually increasing the gap, as soon as the electricity can no longer pass across it." He also discusses the fundamental principle of the process of intensification and that of self-excitation ; regarding the latter he states that the self-excitating machine is nothing wonderful or special and its theory is none other than the theory of the ordinary machine.

Mr. Wimshurst's article is partly of the nature of a reply to this article. He confesses that he has not been able to accept any theory which has been advanced as conclusive or true ; Prof. Holtz bases his views on the existence of two electricities, but the present writer thinks it very much more simple and nearer the truth to take the standpoint that there is but one electricity existing, there being an excess of it on the one end and a deficiency on the other, supplementing this by the further view that all dielectrics behave as though they carry a normal charge forming an elastic film over this surface ; "as an example of this, let us suppose the usual vertical plate of glass upon the table, and that we are about to show the effects of induction ; let us suppose that the plate is coated on both sides with an electrical film ; let a positive charge be brought near to one side ; the film on that side is then pressed in by the positive charge, and the film on the far side is pressed out. If the positive charge be withdrawn, the vertical plate again becomes normal. Then let us again present the exciting positive charge, and at the same time touch the plate on the far side, so as to allow of the induced positive charge escaping ; upon the removal of the exciting charge it will be found that both sides of the plate are negatively charged. To produce equilibrium, the positive charge which was allowed to escape from the far side of the plate must be replaced ; in other words, a positive or excess charge induces another positive or excess charge, and it is only by a supplemental act—that is, the permitting of this induced positive charge to escape—that a deficiency or negative charge is obtained." Applying this hypothesis to the transference of the charges on all the earlier influence machines, he concludes that the fixed conductor plates were conductive of a considerable amount of waste, and that it would be better to make both plates active, rotating them in opposite directions. He gives a brief history of the development of his machine, and adds that he did not know a single feature of the second Holtz machine until after he had been at work for some time, and that the details which he (Wimshurst) added were not intended to contribute to an increase of the charges. He describes the electrical changes which take place in these machines by referring to the accompanying diagram, in which the plates

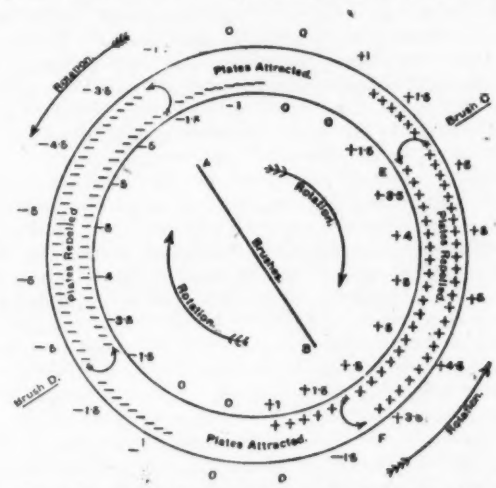


Diagram illustrating the Distribution of Charge in a Wimshurst Machine.

are represented as cylinders and the machine is assumed to be fully excited ; the relative values of the discharges are indicated by numbers, which, however, have no quantitative values. "The front plate passes away from brush *A*, moving to the right with a small — charge followed by neutrality, then a small + charge ; but as soon as it reaches a point opposite the brush *C* the charge increases rapidly, almost to its maximum. This is owing to the considerable transference of electricity from the inner surface of the back plate to the inner surface of the front plate. The maximum charge is reached at about the horizontal line; this condition holds good for a short distance further, when it begins to diminish owing to the leakage toward the brush *B*. At this brush the charge almost vanishes, but a small portion of the charge remains after contact with the brush; then comes neutrality, the second half of the plate follows in the same order. The charges on the back plate follow in a similar manner to those on the front plate, but the rotation of which, it must be remembered, is in the opposite direction. We may now consider the changes which take place between the plates, and it is here the real work is done. Let us commence at the point marked *E*, bearing in mind the hypothetical elastic electrical film. This film on the outer surface of the back plate is pressed in by the brush *C*, (or the excess of electricity is removed by this brush,) the effect of which is to release a considerable charge from the inner surface of the back plate, and this released charge is transfered to the inner surface of the front plate, as shown by the curved arrows. It is this continuous transfer of electricity to the inner surfaces of the plates opposite to the brushes, and its carriage back to the horizontal diameter by the plates, that increases or adds to the excitation, for it must be remembered that these carried charges on the right of the diagram are all +, and all on the left side are—. They being of the same sign, they naturally repel each other; the energy put into the machine, however, thrusts them together and produces the large charges of free electricity of a like sign upon the outer surfaces of the plates. Let us now see what takes place at the top and bottom portions of the plates. Commencing at the brush *B*, a part of the + charge escaped the brush, and is carried to the left. A like + charge is also carried on upon the inner surface of the plate, while at the brush *D* a — charge escapes and is carried by the back plate to the right; the inner surface of this

plate also has its charge of —. These charges on both surfaces of both plates are — on the left hand and + on the right hand; the motion of the plates brings these charges of opposite sign together, and at about the vertical line neutrality of all four surfaces is produced." All these changes were tested by him many times; regarding the sectors, he states that they are necessary evils, and the less there are of them the better; the more metal the more reliable is the machine in damp weather. Although influence machines "are more than a century old, yet we appear to know little about them which can be accepted as reliable."

In Mr. Schaffer's article he points out what he believes to be mistaken ideas and offers a theory of his own; attempts to explain the action have related mainly to the way in which a charge at a given point spreads over the plates; the normal action, when once charged, was deemed to be sufficiently explained by assuming that the combs discharge the sectors, but as a matter of fact the quadrants embraced by the combs are of the same sign and their charges ought therefore to repel one another and the plates are therefore supposed to be neutral from the combs to the next brush in the direction of rotation; he claims that it is this very part of the theory which is most imperfect and the least in conformity with experience; the plates are really not neutral at any point and he shows that the part played by the combs is very different from that actually assigned to them. He shows that one half of the horseshoe combs are useless and even detrimental and concludes that straight combs should therefore be used; the diametral conductor on the same side as the active comb is somewhat detrimental but it is indispensable to prevent reversals; only one such conductor is required and that should be in front of the plate before which the combs are placed. "The most rational form of the Wimshurst machine would thus be provided with the two existing diametral conductors, and two straight combs facing the same plate instead of the horseshoe combs. The best results will be obtained when the diametral conductors are 60 degrees apart and 60 degrees from the combs, and not at right angles to each other and 45 degrees from the combs as at present. This follows from the evidence brought forward as to the part played by the diametral conductors. In ordinary working the active combs must be as far as possible from the active conductor, and in case of tendency to reverse, the two conductors must be as far as possible from each other in order not to interfere with each other." He shows that the new theory is in perfect agreement with experiments and leads to an important result which points to an alleged great improvement; if the closed diametral conductor in the Wimshurst machine is cut and put into connection with the electrodes one ought to obtain twice the output of the ordinary machine; experiments show this to be quite correct, but the machine reverses itself very easily for long sparking distances, but this reversal may be prevented by means of two diametral conductors. He describes and illustrates the arrangement which he finally adopted.

In the editorial, Mr. Schaffer's argument is given about as follows: The discharging part of the machine, usually consisting of two horseshoe-shaped combs connected to a pair of discharge knobs, does not act simply as a discharge apparatus but also as a neutralizing conductor aiding or replacing for the time being in the exercise of that function, one of the two oblique diametral conductors; in this it believes him to be right; many years ago Mr. Wimshurst showed that this discharging apparatus is no necessary part of the machine. Regarding Mr. Schaffer's proposition to remove the superfluous conductor, it is stated that suppose there was a compound dynamo having a badly designed shunt winding, it might be justly stated that the shunt should be removed to increase the output of the machine, but this makes it a series machine which will not excite itself on open circuit. A curious point of difference is pointed out between Wimshurst and Schaffer; the latter "lays great stress on the alleged circumstance that the carriers, after having passed under a comb, are found to be over-neutralized—that is to say, actually charged with charges of reversed sign, which alleged fact he attributes to the influence exerted laterally by the charges upon the neighboring undischarged parts of the plate. Mr. Wimshurst passes the alleged fact in silence, and in his diagram represents the effect of passing a brush not as over-neutralizing, nor as even quite neutralizing the sector." It is stated that it is now well recognized that the length of the spark is limited by the internal insulation of the machine and that the quantity of the output is proportional to the speed and to the amount of surface charged and discharged in each revolution. The point which is not yet properly appreciated is that the operation of charging any sector or carrier and making it impart its charge in part of the apparatus, really consists in charging a simple condenser to a certain potential and then raising this potential by pulling apart the dielectric which lies between the charged carrier and the oppositely charged body with which it was previously in proximity. The output of a machine of given size and speed cannot be increased until it is understood how to increase the mutual capacity of the two parts and their degree of electrification without causing wasteful internal discharge in the operation of charging them and then separating them from one another.

Practical Testing.—The serial of Messrs. Freedman and Osterberg is continued in "Elec. Power" for August; they discuss the measurement of insulation resistance by the voltmeter method. They give the following rule: Measure the E. M. F. of the machine, divide it by the deflections of the voltmeter when the insulation resistance is in the circuit, subtract one from this ratio and multiply the remainder by the resistance of the voltmeter; by this simple method the insulation resistance is determined directly with nothing but a direct reading voltmeter whose resistance is known.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telegraphing without Wires.—The Lond. "Elec.," July 19, contains a communication by Mr. Wilkins in reply to a recent article by Prof. Dolbear claiming American priority (see Digest, June 15). Nearly 50 years ago and 30 years before Prof. Trowbridge made his original researches, Mr. Wilkins made researches in this same direction and published the results a year or two later in the "Mining Engineer" (English), March 31, 1849; the system appears to have been the same except that he used a delicate form of galvanometer in place of the telephone; he suggested the erection of lengths of telegraph wires on the English and French coasts with terminals dipping into the earth or sea and as nearly parallel as possible to one another. He attaches importance to the apparatus rather than to the system. He at that time believed that the earth acted as a reservoir or condenser rather than as a return conductor. The magnetic influence of a wire carrying a current also suggested itself to him at that time and he succeeded in obtaining actual signals between elevated wires about 120 feet apart (but it appears that the lines were grounded); he continued the experiment with wires a considerable distance apart and with no approach to parallelism. In 1849 he published a description of an instrument which was made and used not only in England but in America also, "which turns out to be the only thing applicable or possible to be availed of in the accomplishment of recording signals in ocean telegraph—even at the present day." The instrument which he described in the above reference was patented at least twice in the United States subsequently, the last time within a year or two, when it was described as a new invention in a prominent American journal.

Telegraphy in Corea.—From an article in the "Elec. Friend" (Japan) for June, explaining the construction and management of telephone circuits for the benefit of the natives of Corea, it appears that the total length of the telegraph wire in that country is 875 miles.

MISCELLANEOUS.

Overhead Wires as Lightning Protectors.—Mr. Grandy of the Postal Telegraph Company, of St. Louis, in a communication to the "Elec. Eng.," July 31, calls attention to the fact that during the present Summer while severe lightning storms have been of frequent occurrence in all directions and within 10 or 15 miles of that city, yet the city itself has been remarkably free from electrical disturbances; not a fuse has blown nor an arrester plate been grounded by lightning on his company's switchboard this season. This and the previous season are in marked contrast with previous years when the blowing of fuses and burning of instruments were of frequent occurrence. He suggests that the extension of trolley and lighting current wires throughout the city during the past two years may be responsible for this immunity from severe lightning storms. Editorially it is stated that these observations are in accord with previous experience under like conditions, and that there can be little doubt that the overhead wires act as protection to a considerable extent.

Annual Meeting of the Union German Electricians at Munich.—The "Elek. Zeit.," July 18, gives a brief summary of the proceedings at the third annual meeting of the society called the "Verband Deutscher Elektrotechniker," which took place in Munich, July 4 to 7. The programme consisted largely of visits to installations of interest to electricians, and of social reunions, and with the exception of the comparatively few papers read, the proceedings were largely of local interest. The papers will be abstracted in the Digest when they appear in print.

The number of members in this union is 1,543, or more than double that in the previous year. The subjects of commerce with Japan and electricity at exhibitions were discussed. The committee on the unification of switches, fuses, screws and wire sizes, made a final report in which an agreement was reached, the results of which will be of great value to the electrical industry of Germany. A prize of $75 was offered for the best construction of band fuses, which do not admit of being interchanged. The committee on rules and regulations had to report that they had not yet been able to reach an agreement. A monument to Ohm was unveiled with appropriate ceremonies. The next annual meeting will be held in Berlin. One of the places of interest visited was the large power plant to utilize the water power of the Isar River near Munich. The total available power is 6,000 hp, which will be utilized in three stations of 2,000 hp each. Only one is completed at present and contains three turbines of 500 hp each, coupled by means of conical gears with three-phase generators running at 150 revolutions, and generating current at 5,000 volts. Three-phase currents are used for the motors, but for lighting only one of the three-phased branches are used, the same as in the Dresden installation which was described in the Digest last week. An account, referring chiefly to the non-technical features, is given in the Lond. "Elec. Eng.," July 19; it includes a brief description of the Isar works in which three-phase currents generated at 5,000 volts are transmitted a distance of 5.62 miles with a loss of only 9 per cent., the power of the generator being 1,000 hp; motors aggregating 140 hp are used so far; a map of the district is given.

Lightning Flash in Ben Nevis Observatory.—Some details of the recent severe lightning flash, which came near destroying the observatory, are given in the Lond. "Elec." and "Elec. Rev.," July 19. Whenever a thunder storm passed the summit a discharge invariably occurred from metallic bodies in the observatory. In the present case repeated clicks were heard in the telegraph instruments, when suddenly the whole office was filled with a brilliant flash and deafening roar, a pillar of smoke issuing from the telegraph instrument and stove pipe; it was followed by a second and lighter discharge; many portions of the telegraph wire and apparatus were fused, and much other damage done; there was a heavy fall of snow at the time; the lightning protector was badly fused, the plates showing a patch of fusion as large as a sixpence, which is thought to have saved the cable; the insulation of the connecting wires was melted off, and in some cases the copper was melted, setting fire to the woodwork. The vacuum protector at the base of the mountain was fused, but only slightly, the main discharge having expended itself on the summit; St. Elmo's fire was strongly "felt and heard" for some hours afterward.

New Books.

ELECTRICAL LABORATORY NOTES AND FORMS.—By Dr. J. A. Fleming, M.A., F.R.S.; London: The Electrician Printing and Publishing Company; 240 7½ by 2½-inch pages. Price, $4.00.

This book is made up of a series of 20 elementary and 20 advanced exercises and experiments in practical electrical measurements and testing, as given in the laboratories of University College, London. Each exercise has six pages devoted to it. In the elementary ones two pages are of printed matter and four are ruled blanks for the recording of the results of observation and calculation on the part of the student. The larger part of the advanced exercises have three pages of printed matter. Each exercise has a number, title, blank for name of student and date of experiment, and list of apparatus required for performing it. Then follows a development of the theory at the basis of the exercise, specific directions how to perform it, and often precautions which must be taken to secure good results. There are many references to standard works. The columns of the ruled blanks have printed headings indicating what is to be entered therein. The veriest dunce could not fail to hand in a systematic report with such facilities.

The exercises are very practical and their employment must result in an economy of time on the part of both instructor and student. It is questionable whether an instructor, whose laboratory is invaded by a board of electrical engineering students, can get even respectable results from them without the use of some system of blanks. To be able to make a systematic record of observations is essential before a student can be called educated. While one may absorb much from the continuous filling in of blanks well systematized by some other person, he will sooner begin to create system after having been sent back a few times to measure the distance between a galvanometer mirror and a *moved* scale or make some similar measurement.

In Exercise 4 the student is asked to "note that the sign ω stands for ohms." It is used throughout the book to denote angular velocity. In Exercise 17 "foot-pounds" and "feet-pounds" are used in the same sentence. Exercise 9 is intended to acquaint the student with the use of the Postoffice pattern of Wheatstone's Bridge. As a problem he is required to determine the temperature coefficient of a coil of wire. One would hardly expect to get very accurate results by this method and the student, never having heard of the Carey-Foster method, might think that all temperature coefficients were determined in this manner. In the majority of the ballistic galvanometer determinations, the galvanometer is calibrated by means of a discharge from a standard condenser on open circuit. The throw of the galvanometer on closed circuit is then corrected by introducing the logarithmic decrement. While this is proper, it is bothersome for students and is liable to introduce errors and inaccuracies. The galvanometer can be directly calibrated by employing a double tongued key. This can be made to close the galvanometer through a resistance (generally less than an ohm) equal to that of the working circuit immediately after the discharge of the condenser.

The following is a list of the exercises:

Elementary Series.—The exploration of magnetic fields; field of a circular current; standardization of a tangent galvanometer by the water voltmeter; measurement of electrical resistance by the divided wire bridge; calibration of the ballistic galvanometer; determination of magnetic field strength; standard magnetic fields; magnetic field in the air gap of an electromagnet; resistance with the Postoffice pattern of Wheatstone's Bridge; potential difference by the potentiometer; current by the potentiometer; complete report of a primary battery; standardization of a voltmeter; photometry of incandescent lamps; absorptive power of semi-transparent screens; reflective power of various surfaces; electrical efficiency of motor by cradle method; efficiency of a motor by brake method; efficiency test of a combined motor-generator plant; test of gas engine and dynamo plant.

Advanced Series.—Specific resistance; low resistance by potentiometer; armature resistance; standardization of ammeter by copper deposit; standardization of voltmeter and ammeter by potentiometer; permeability of iron; standardization of high-tension voltmeter; examination of alternate-current ammeter; alternating-current curves; efficiency tests of a transformer and alternator; photometry of an arc lamp; insulation resistance; complete test of a secondary battery; calibration of electric meterse hy-teresis curves and losses; capacity of concentric cables; Hopkinson test of a pair of dynamos.

Any exercise or combination of exercises can be purchased unbound from the publishers. All the exercises are not, however, complete in themselves, as many of them have references to preceding ones. Those which are so connected form, however, a natural group.

Announcement has been made by the W. J. Johnston Company, New York, of the following books, now in press:

THE THEORY AND CALCULATION OF ALTERNATING-CURRENT PHENOMENA.—By Charles Proteus Steinmetz.—This will be the first work yet written in any language dealing in a complete and logical manner with all of the phenomena of alternating currents and their calculation in the design of alternating-current machinery. In the first six chapters the various primary conceptions and methods of treatment are developed, the use of complex quantities being explained in a remarkably clear and effective manner. The various alternating-current phenomena are then taken up in turn, the more complex parts of the subject being approached so gradually and with such a logical preparation that little if any difficulty will be met in their understanding. The remaining chapters of the book, forming half of its contents, are devoted to the methods of calculation of transformers, simple, alternating and polyphase generators and motors, all of the various reactions involved being thoroughly analyzed and discussed. The work contains the very latest knowledge relating to alternating-current phenomena, much of which is original with the author, and will here appear for the first time in book form.

LESSONS IN ELECTRICITY AND MAGNETISM.—By Prof. Eric Gerard, Director of L'Institut Electrotechnique Montefiore, University of Liegé, Belgium. Translated under the direction of Prof. Louis Duncan, Ph.D., Johns Hopkins University. With American additions as follows: A Chapter on the Rotary Field, by Dr. Louis Duncan; A Chapter on Hysteresis, by Charles Proteus Steinmetz; A Chapter on Impedance, by A. E. Kennelly; A Chapter on Units, by Dr. Cary T. Hutchinson.—As a beautifully clear treatise for students on the theory of electricity and magnetism, as well as a résumé for engineers of electrical theories that have a practical bearing, the work of Prof. Gerard has been without a rival in any language. As a text-book of reference it has been largely used in American colleges, the logical methods of the author and his faculty of lucid expression and illustration simplifying to students in a remarkable manner the understanding of the various subjects treated. The scope of the present translation has been limited to those parts of the original work treating of theory alone, as the practical portions would not have the same value for American students as for those to whom the book was originally addressed. In order to make it a treatise comprehensive of all electrical theory having a bearing on practical work, and to bring the subject-matter up to date, several chapters written by American authors are added. As will be seen above, the authors of these chapters are authorities on the several subjects with which they deal, and the work as thus extended will form the most complete treatise yet published relating particularly to general electrical theory as it enters into the domain of the engineer.

ELEMENTARY ELECTRO-TECHNICAL SERIES. By Edwin J. Houston, Ph. D., and A. E. Kennelly, Sc.D. Ten volumes, as follows: Alternating Electric Currents.—Electric Heating.—Electromagnetism.—Electricity in Electro-Therapeutics.—Electric Arc Lighting.—Electric Incandescent Lighting.—The Electric Motor.—Electric Street Railways.—Electric Telephony.—Electric Telegraphy.—The publishers state that they have undertaken the publication of these volumes because they believe that a demand exists on the part of the general public for reliable information regarding such matters in electricity as can be understood by those not trained in electro-technics. The reputations of the authors and their recognized ability as writers are a sufficient guarantee for the accuracy and reliability of the statements. The general public will find in these works concise and authoritative statements concerning the various branches of electrical science treated in the separate volumes. The entire issue, although published in a series of 10 volumes, is, nevertheless, so prepared that each volume is complete in itself and can be understood independently of the others. Each of the volumes is to be profusely illustrated, printed on a superior quality of paper and handsomely bound in covers of a special design. The volumes will be published at intervals of a month, the first to appear August, 1895.

ELECTRICAL BOATS AND NAVIGATION. By Thomas Commerford Martin and Joseph Sachs, New York. C. C. Shelley. 232 pages, 143 illustrations. Price, $2.50.

We have in this book the first connected account of the various attempts, successful and otherwise, which have been made to apply electricity to the propulsion of boats, either for pleasure or commercial purposes. These applications have taken various forms: as the use of primary batteries, the use of storage batteries, and the use of trolley and wire, or of a towing motor or traveler, as in the various proposed methods for canal-boat propulsion.

These various methods are treated both from their historical and present-day aspects, and on both the electrical and nautical or marine sides.

The work, as a whole, is especially good from the descriptive and general standpoint, is fully illustrated, and contains in a well-written manner an interesting account of the various topics coming under its subject head.

Taking certain features of the book more particularly, it may be said that on the whole the electrical side is more satisfactory than the nautical. This presumably arises from the greater familiarity of the authors with this side of the work, and its greater relative importance in a subject of this kind.

The nautical side bears evidence of having been drawn mostly from the various works constituting the well-known literature of the subject. This is only natural, but the lack of familiarity with the subject has led the writers into many statements which are in a greater or less measure misleading, and to place relative importance on various considerations somewhat out of proportion to that presumably intended in the original works.

As instances, mention may be made of the statement and implication frequently met with, that a propeller of low-pitch ratio has generally, or necessarily, less slip and higher efficiency than one of high-pitch ratio. This errs in assuming that efficiency continuously decreases as slip increases, instead of decreasing on either side of a maximum value, which is usually found at about 15 or 20 per cent. true slip. The assumed superior efficiency of low-pitch propellers is also unsupported by either theory or experiment. Such data as is available, due to R. E. Froude, show that there is but slight change for a wide range in pitch ratio. The amount, in fact, is so slight that it might be readily masked and reversed by slight variations in area of blades, thickness, shape, quality, etc., and such difference as was discernible in Froude's experiments seemed to tend in the direction opposite to that stated by the authors.

Again, there is the general implication throughout that part of the work relating to canal-boat propulsion, that the wash on the banks is due to the current of water driven aft by the propeller. This is misleading, for the wash fundamentally is due to the wave formed by the motion of the boat through the restricted channel, and the propeller, directly, has little to do with it. For equal speeds with a towed or propelled boat, there is but little practical difference in the wash.

Again, there abound throughout that portion of the book relating to launches, statements of powers and speeds attained, which are entirely out of proportion. This, of course, arises from having taken the statements or guesses of owners or interested parties. A little computation readily shows that in many cases cited, the speed for the power developed or weight of battery carried is preposterous.

Again, it is stated that the loss of power through the propeller is usually from 15 to 30 per cent. of that applied to the shaft. This should be rather from 30 to 40 per cent., as there is no authentic account of a propeller efficiency greater than about 70 per cent.

Instances of this character might be multiplied, but those mentioned serve to illustrate the point. It may be suggested that it would have been better if the authors had not attempted to combine an elementary treatise on resistance and propulsion with the more proper subject-matter of their book. Such treatment as they are able to give is necessarily quite incomplete, and from either the practical or scientific standpoint, quite unsatisfactory.

A further criticism may perhaps be made in the fact that the inherent limitations of this mode of propulsion, especially with storage batteries, are not plainly pointed out. It is well known that such limitations exist by reason of the excessive weight of the batteries, and where a long time of service or a very high speed is required, their weight becomes entirely prohibitive. It is surely no kindness to the electrical industry to pass this point over without clear and explicit treatment. Misunderstanding on these points might lead to disappointment through expectations which, from the very nature of the case, can never be realized.

The general impression obtained by reading the book where individual instances of electric launches are adduced in large numbers, would be that this mode of propulsion is more definitely established, and its all-around superiority more surely determined, than the actual facts seem to warrant. It must be remembered that the entire field in its present aspect is new, and that, especially in a commercial way, the electric launch has not yet demonstrated its superiority over some of its rivals, even in its own field of short runs for pleasure purposes.

One of the interesting and valuable features of the book is found in the tables furnished by Mr. J. C. Chamberlain, who has been intimately associated with the development of the modern electric launch. These tables give the size, power, weight, speed, cost and other important particulars of electric launches and tenders of various sizes, and may, without doubt, be accepted as representing the best possibilities in this direction at the present time.

The general treatment of the application of electricity to canal-boat propulsion contains many good points, and its conclusions seem generally well founded. The various methods which have seemed suitable for this purpose are quite fully described and compared. Perhaps, relatively, too much space is given to a method proposed by one of the authors, especially in the financial computations, by means of which its superiority over other methods is shown.

As a whole, the book will be found an interesting contribution to the rapidly growing literature of the electrical industries, and if attention is here called to certain features less worthy of commendation it is because the reviewer's duty to the public requires the exercise of all possible care lest high standards of scientific writing be allowed to decline.

An Experiment in Water Wheel Governing.

BY WILLIAM W. HANDY.

It is well known among engineers that water wheels constitute the most difficult class of prime movers to govern, and also that prime movers require very close regulation when running dynamos.

Now just at this time, when water power is being so largely used for electrical transmission, the need of good governing is more felt than ever before.

In an experiment carried out by the author on a turbine plant supplying current for incandescent lighting, very good regulation was obtained by means of a simple electric governor.

The diagram, Fig. 1, shows the principle on which the governor works. Connected to the dynamo 1 is a shunt coil 2 and a series coil 3. These coils are connected to the dynamo in such a way that the action of one opposes that of the other. The coils attract a plunger 4, which is suspended from a lever 5; 14 and 15 are mercury cups into which the ends of the lever may dip. These cups are connected as shown to the magnets 7 and 8; 6 is a storage battery connected, as shown, to the lever and the magnets. It is readily seen if the lever 5 moves from a central position it closes the circuit through one of the mercury cups and causes one of the magnets 7 or 8 to become excited.

These magnets act on an armature *I*, which is connected by the spring 10 to the double pawl 11. The pawl obtains constant reciprocating motion

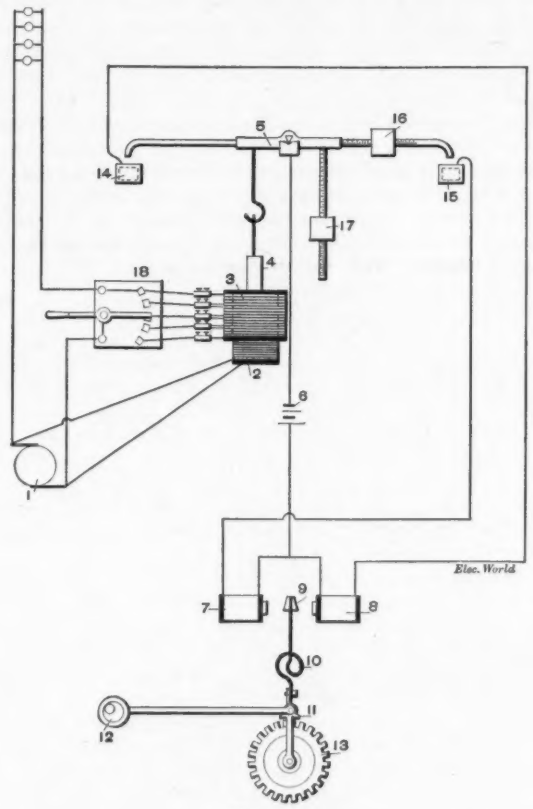


FIG. 1.

from the eccentric 12, which in turn obtains constant motion from the water wheel. As the armature is attracted by one or other of the magnets the pawl is caused to engage with the ratchet wheel 13, and turn it in a direction depending on which magnet attracts the armature. The ratchet wheel is connected to the gate shaft of the water wheel, and as the ratchet wheel turns the gates are opened or closed, thus governing the speed of the water wheel. When neither of the magnets are excited, and therefore the armature not attracted by either, the pawl is held in a central position by means of a spring not shown in the diagram, and the ratchet wheel and therefore the gates remain still.

Now suppose the dynamo is running at the right voltage with no load on, and consequently with a current through the shunt coil 2 only, the weights 16 and 17 being adjusted on the lever so as to balance the pull of coil 2 just sufficient to keep the lever in a central position. Now when the full load is thrown on the dynamo, it is desirable in constant potential distribution to keep the voltage constant at the end of the line, and this is attained by this governor in the following manner: Due to the increase of load, and the consequent decrease of speed and voltage, the current through the series coil 3 will increase and through the shunt coil 2 decrease. The pull on the plunger will decrease, and the lever will make contact in cup 15, magnet 8 will be excited, the armature 9 attracted by it, and the pawl will turn the ratchet wheel 13 so as to open the gates. This will continue until the speed and therefore the voltage has increased sufficient to increase the pull of the shunt coil 2 and break contact at 15, when the governor will stop working. Now if the strength

of the series coil 3 has been properly adjusted by means of the switch 18, contact will not be broken at 15 until the voltage of the dynamo has been increased to the desired amount to overcome the drop on the line, and keep the voltage at the end of it what it was for no load. Now if the load is decreased it can readily be seen that the lever will make contact at 14, and cause the gates to close, and this will continue until the voltage has decreased sufficient to break contact at 14. The voltage for this load will be found to be the proper value to keep the voltage constant at the end of the line.

The practicability of this governor has been demonstrated, and the

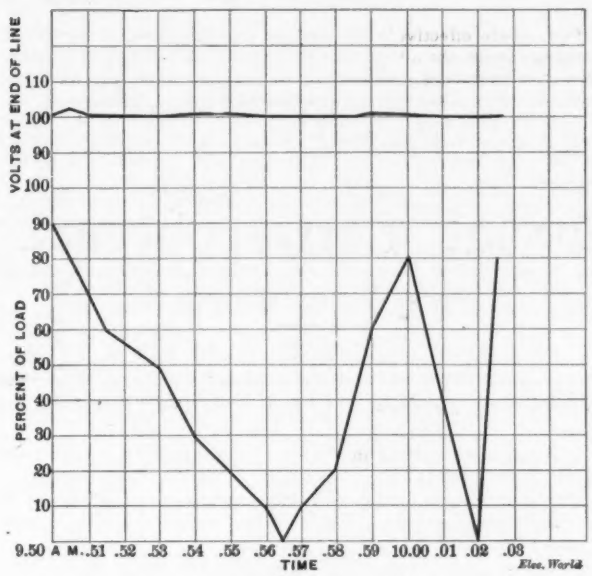


FIG. 2.

curves shown in Fig. 2 give the results of a test taken from a small plant on which the governor was working. The dynamo was a continuous-current shunt-wound machine, used for incandescent lighting at 100 volts. The water wheel was a Burnham turbine, with register gate. The drop on the line was 7 per cent. at full load, and a constant voltage was desired at the end of it. The readings shown by the curves were taken at the end of the line, and show very plainly that under extreme variations of load the voltage was kept practically constant, the difference between the highest and lowest reading on the voltage curve being only two volts.

Vibrating Push-Button.

We illustrate herewith a combined tell-tale and push-button which has been patented and is being put on the market by the R. & B. Manufacturing Company, of 1814 Fairmount Avenue, Philadelphia, Pa. The device consists of a small magnet and armature mounted within the push-button case and connected in series with the contact spring, so that the vibrating bell at the other end of the circuit will operate the armature within the push-button and indicate to the person signaling

TELL-TALE PUSH-BUTTON.

that the signal has been properly transmitted. Absence of the clicking sound produced by the armature indicates, of course, that something is wrong and that the signal has not been reproduced by the bell at the other end. The device is about the same size and appearance as an ordinary push-button, and can be substituted for the latter without any change whatever in wiring, just as though it were identical with the button displaced. The great convenience afforded by being able to tell instantly whether or not a signal has been transmitted properly is obvious to any one who has called repeatedly without response and is left in utter ignorance as to whether the signal was transmitted, or whether the lack of attention was due to the negligence or absence of the person summoned.

Conduit-Motor Railway Systems.

Mr. J. F. Mc Laughlin, of the Electro-Magnetic Traction Company, Philadelphia, in a letter to us, states that the Thwaite-Cawley system of electric traction described in the Digest of July 27, is broadly covered by a patent granted to him July 15, 1890, on an application filed January 30, 1890. The English system as described, consists, briefly, of a large conduit in which motors are mounted on a truck running on rails, the car on the track above being propelled through the medium of a driving arm which passes up through a slot in the conduit. The specification of the McLaughlin patent describes the system as consisting of a conduit provided with two pairs of conductors, each of which consists of tracks on which travel the wheels of a truck containing one or more electric motors, these wheels being so arranged that they are forced into strong frictional contact with the conductor tracks, thereby obtaining both a good electrical contact and strong tractive force. The motor truck is connected with the surface car to be driven by an arm extending upward through the slot usually provided in underground conduits for electric railways. The motor truck is also so connected to the car to be driven that the weight of the car is in a measure borne by the truck and the traction of the latter on the conductor rails is thereby increased, provision being made for the slight vibrations of the car to be driven when in motion.

A short line in Philadelphia is shortly to be equipped with the system of the Electro-Magnetic Traction Company, and when in operation an account of the same will appear in our columns.

Raw Silk Machinery Wipers.

A peculiar industry, as original as useful, sprung into existence some years ago, and although at the first glance it would seem that its importance is quite speculative and the demand for the product still more so, the originator of the industry has, through perseverance and energy, based on the sure conviction of its merits, placed it on a sound commercial basis. The American Silk Manufacturing Company, of 311 Walnut Street, Philadelphia, founded by Mr. Felix Haac, eight years ago, and starting from a small beginning in St. Louis, Mo., is now enjoying the custom of many of the largest railways and electrical plants in this country, and its raw silk machinery wiper is now recognized as a practical means to economy, and a labor-saver in the long run, notwithstanding the fact that these wipers require frequent washing out.

In Vienna, Austria, where Mr. Haac introduced the silk wiper for the first time in 1880, the washing of the wipers was considered no obstacle, and the silk machine wiper, therefore, soon found a ready market. Conditions were found to be different, however, in this country; the idea of washing greasy wipers did not agree with the liberal-minded superintendent, who had first to consult his foreman and ascertain if his men would like such material, and it was found necessary for the more general introduction to devise means whereby the prejudice against the washing could be overcome. A special compound was therefore prepared in the shape of a powder for use with the wipers, which is not injurious to the wiper and is economical and efficient in weak solution, so that the work for cleaning is shortened and rendered easier, while the wiper does not accumulate so much grease and dirt, most of it being left in the solution used for cleaning.

Although the progress of introducing the silk wipers was slower and comparatively more difficult in this country, than in Europe, the introduction was greatly facilitated by the development of electrical industries, all the electric light and power plants of any size being anxious and ready to adopt any real measure of economy or increased safety, both of which conditions are satisfied by silk wipers, inasmuch as they can be used repeatedly, and are devoid of liability to spontaneous combustion.

American Lamps Abroad.

The business depression of the last two years having made necessary new economies in American manufacture to keep up with the gradual fall of prices, a general benefit has resulted in the shape of improved mechanical appliances that have not only lessened the cost of production, but what is far more important, have raised the standard of excellence so that buyers now feel that in buying incandescent lamps better goods should be obtained than were available several years ago. As this desire cannot be satisfied by the old-fashioned methods in use abroad, the natural result is that the more reliable American product will obtain a strong foothold, especially with shrewd European buyers.

Realizing the force of this argument, and having met with an encouraging reception in the sale of lamps in Europe, the Bryan-Marsh Company, of 136 Liberty Street, New York, has arranged to establish a permanent branch in London for the handling of its product on that side of the Atlantic. A branch house has already been established in Canada by this enterprising concern.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Aug. 3, 1895.

AMERICAN BELL, WESTINGHOUSE AND GENERAL ELECTRIC were practically inactive throughout the week, the telephone stock reacting slightly from Monday's opening, while the two others were almost stationary. The lift given the Bell stock by last week's instrument report appears to have been spasmodic, though the trading was scarcely extensive enough to indicate the feeling on this point.

ELECTRIC STORAGE braced up on Wednesday and displayed the most bullish aspect that has characterized the stock this year, jumping from 29, where it has laid almost dormant for weeks upon weeks, up to 34, and continuing to climb and show strength straight through to-day's closing.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	120	125
Edison Electric Ill., New York	100	100	100
" " " Brooklyn	100	..	108
" " " Boston	100	129	130
" " " Philadelphia	100	..	115
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	39	39½
General Electric	100	35½	36
General Electric, pref	100	69	71
Westinghouse Consolidated, com	50	36	36¾
" " pref	50	53	54

BONDS.

Edison Electric Ill., New York	105	105½	105½
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	..	90¼

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	195	195½
American District Telegraph	100	33	40
American Telegraph & Cable	100	96	..
Central & South American Telegraph	100	117	120
Commercial Cables	100	150	..
†Erie Telephone	100	57¾	58
Gold & Stock Telegraph	100	105	..
New England Telephone	100	87	87¾
New York & New Jersey Telephone	100	103	105
Postal Telegraph-Cable	100	63½	..
Western Union Telegraph	100	92	93⅛

ELECTRIC TRACTION STOCKS.

Baltimore Traction	25	20	20½
Binghamton RR. com	100	100	..
Brooklyn Traction	100	17	19
" " pref	100	..	53
Buffalo St. Ry	100	85	88
Cleveland City Ry	100	68	70
Cleveland Electric Ry	100	59	60
Chicago City Ry	100	305	315
Columbus St. Ry	100	48½	..
Consolidated Traction of N. J	..	26	30
‡Electric Traction, Philadelphia	50	..	74
Hestonville	100	58	58½
Long Island Traction	100	10	10¼
Louisville St. Ry. com	100	37	39
" " " pref	100	87	88
New Orleans Traction	100	24	27
" " " pref	100	69	71
North Shore Traction	100	34½	37
" " pref	100	84	88
People's Traction $30 pd	25	65	65¾
Philadelphia Traction	50	84¾	84⅞
Rochester St. Ry	..	38	..
Union Ry. (Huckleberry)	100	112	115
West End, Boston	100	74	75
" " pref	100	..	20
Worcester Traction	100	18	20
" " pref	100	86	90

BONDS.

Buffalo St. Ry. 1st con. 5s	100	106	109
*Binghamton Railway Co. 5s	100	99	100
*Columbus St. Ry. 1st 5s	100	104	..
Rochester St. Ry. 1st 5s	100	95	97
*Union Ry. 1st mtge 6s	100	105	108
*Westchester Electric 1st mtge 5s	100	98	101

* With accrued interest.
† Ex-Div.
‡ Ex-rights.

THE TRACTION CONSOLIDATION at Philadelphia continues to furnish food for some vigorous discussion, *pro* and *con*. It is stated on good authority that the Union Traction Company will start in with $10,000,000 paid-up capital, from which about $3,000,000 will be taken by improvements now in progress and in contemplation. Much confidence is expressed in the ability of President John Lowber Welsh to make the scheme a success.

HESTONVILLE occupies a peculiar position with relation to the new combine. The company is earning fair returns upon its investment already, and in the event of hostile demonstration from the Union Traction Company, such as rearranging its transfer system so as to divert travel from the Hestonville road, the latter could retaliate effectively by cutting fare to 3 cents. This procedure the new company could not afford to follow, while it is well known that Hestonville can earn operating expenses and fixed charges on a 3-cent fare. It would seem, therefore, that the Hestonville Company's position is by no means deplorable. Its gross earnings for the first half of this year were $283,567 against $162,964 for the same period last year. Notwithstanding the good showing made, however, the stock is persistently declining on the Philadelphia exchange floor.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
253 BROADWAY, NEW YORK, Aug. 5, 1895.

MR. FRANK DE RONDE, of P. & B. fame, has left for a short Western trip.

R. B. COREY is home again, and is apparently satisfied with his Western trip.

F. G. FULLER, known to fame in Western circles as "Pop" Fuller, was a New York visitor this week.

H. A. REED, mogul of the Bishop Gutta Percha Company, is on his vacation. He will return in about ten days.

FLUSHING, L. I.—Citizens are agitating the question of better lights. A strong effort will be made to have the village lit by electricity instead of gas as at present.

INCREASE OF CAPITAL STOCK.—The Municipal Electric Light Company, Brooklyn, has voted to increase its capital stock to $1,000,000 for the purpose of improving its system.

J. T. HAMBAY, general manager of the Beacon Lamp Company, of Boston, was a visitor in New York last week, and is now on a trip to Chicago and other Western cities.

C. O. BAKER, refreshed from his sojourn abroad, is again absorbed in business. He says the recent rise in platinum has been forced by the mine owners, but he thinks it will not seriously affect lamp manufacturers.

DIEHL & CO., 385 Broadway, New York, having closed an eminently successful ceiling fan season, are turning their earnest attention to the perfection of their line of motors. These machines are certain of a warm reception.

THE AUTOMATIC ELECTRIC SPECIALTY COMPANY, 136 Liberty Street, New York, has completed all plans for the illuminated fountain it is equipping in Newark, N. J., and will give an exhibition in the near future.

THE BRYAN-MARSH COMPANY, of 136 Liberty Street, New York, reports that the West End Street Railway, of Boston, Mass., after a most exhaustive test, have adopted the Bryan-Marsh lamps and closed a contract for its annual supply.

THE PUBLIC TELEPHONE COMPANY, of the Thames Building, New York, reports that everything is progressing satisfactorily to the perfection of its financial plans. It has a surprise in store for the industry that will be sprung in the near future.

THE INTERIOR CONDUIT & INSULATION COMPANY, 527 West 34th Street, New York, is one of the busiest manufacturers in the country just now. The sales of Lundell fans has been unprecedented this season, notwithstanding the coolness of the weather.

THE SOLAR ELECTRIC COMPANY, 657 Duane Street, New York, now handling the product of the Solar Arc Lamp Company and the Brooklyn Electric Company, has perfected its organization and factory in Duane Street, and is handling a large business with smoothness and dispatch.

THE REV. GEO. H. RUSSELL will shortly give an exhibition at some place in New York City not yet designated, of a new telephone which, it is claimed, will speak over circuits of any length, and enunciate so loudly and distinctly that conversation can be heard 50 feet distant from the receiver.

THE COLUMBIA TELEPHONE MANUFACTURING COMPANY, 138 Front Street, New York, would like its friends to know that it has no connection with the Columbia Telephone Company, a notice concerning which recently appeared. The Columbia Manufacturing Company is particularlarly busy for this season.

RECEIVER FOR ELECTRICAL ENGINEERS.—Judge Stover, in the Supreme Court, last week, appointed Duncan Edwards receiver in supplementary proceedings for Neftel, O'Connor & Co., electrical engineers, of 126 Liberty Street, New York, in a suit brought against them by John A. Roebling's Sons Company.

AN OPPOSITION TELEPHONE COMPANY is being organized in Hoboken to compete with the New Jersey Telephone Company. It is proposed to make the rates for commercial houses $36 per annum, and for residences $12. The promoters are sanguine of obtaining 500 subscribers at the business rate and a large proportion of the private house custom.

THE ANCHOR ELECTRIC COMPANY, of Boston, has opened a New York office in the Havemeyer Building, 26 Cortlandt Street, in charge of Mr.

A. B. Field, whose territory will include New York, Philadelphia, Baltimore and Washington. The "Iona" and other specialties of the Anchor Company are so well known generally that Mr. Field will be spared much of the usual pioneer work, and should meet with much success in extending their use.

TROLLEY PARTIES IN BROOKLYN.—President Rossiter and Secretary Williams, of the Brooklyn Heights Railway Company, are having built for use on the two hundred or more miles of trolley roads under their management a number of elaborate open cars, with many special features of comfort and convenience, for the use of trolley excursion parties, such as have become so popular in Philadelphia, Baltimore and several other cities. The cars will be longer than those now in use, and will be both costly and luxurious. Five or six special closed cars are also to be built, intended for the use of theatre parties. The elaborate electric lighting effects of all these new cars will make of them quite a pyrotechnic spectacle as they whiz through the city streets and suburbs.

THE ELECTRIC LIGHTS IN THE BRIDGE CARS.—The electric lights in the bridge cars have not yet been accepted by the trustees, but Superintendent Martin says there will be no question about accepting them when the term of probation expires, which will be soon. He regards the lights as entirely satisfactory, and so do all who have occasion to travel on the bridge cars at night. When the lights are the actual property of the bridge it is the intention to run them all night, but just now there is a possibility that during the changes which are to be made in the New York station it may be necessary to suspend the use of them temporarily and to leave the cars with nothing but the oil lamps that have produced so much dissatisfaction in the past. During the alterations there will be a good deal of hoisting of material, etc., and it is feared that the trolley wires will be so greatly in the way that it will be desirable to get rid of them entirely for a time. This will not be done, however, unless it is found unavoidable.

PRESIDENT COCHEU WILLING TO RESIGN.—There was a meeting of the State Electric Light Company at the offices of President Theodore Cocheu on Broadway, near Berry Street, on last Thursday afternoon. It was rumored after the meeting that a majority of the Board of Directors was opposed to the president, and that there had been several resignations and a new election of officers. The trouble, it was asserted, started last Monday, when certain payments were about to fall due on the plant at South Ninth Street and Kent Avenue, the manufacturers insisting upon immediate settlement for apparatus furnished. It was also rumored that an effort would be made to raise $1,000,000 through Seligman Bros., the bankers. Theodore Cocheu denied the rumor of trouble in the board. He said a number of stockholders had offered to resign or do anything for the benefit of the company. "If I could see that my resigning would be any benefit to the company, I would certainly do so," added Mr. Cocheu. Another meeting will be held this week.

SECRECY OF TELEPHONE MESSAGES.—The new law in regard to the maintenance of secrecy by telephone employees, as to messages passing over the wires, will come into operation on Sept. 1. It requires the staff of the telephone companies to be as secretive regarding the nature of their business as are the men and women who handle the telegraph messages. A person who either wrongfully obtains or attempts to obtain knowledge of telegraphic or telephonic message by connivance with a clerk, operator, messenger or other employee of a telegraph or telephone company, or, being such operator or other employee, wilfully divulges to any one but the person for whom it was intended the contents or the nature of telegraphic or telephonic message intrusted to him for transmission or delivery or of which contents he may in any way have become possessed, is punishable by a fine of $1,000 or six months' imprisonment, or both. The same penalty attaches to neglect or refusal to transmit or deliver messages, except when they are intended for illegal purposes.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
ROOM 91, Hathaway Building, 630 Atlantic Ave.,
BOSTON, MASS., Aug. 2, 1895.

THE SIEMENS & HALSKE ELECTRIC COMPANY, of America, has removed its New England office, of which Mr. Henry C. Radford is manager, to the Equitable Building, Boston.

THE CENTRAL ELECTRIC COMPANY, of New Britain, Conn., has decided not to pay the tax of 2 per cent. on gross receipts levied by the city, and will contest the constitutionality of the ordinance levying the tax.

LOWELL, MASS.—The Lowell, Lawrence & Haverhill Company has petitioned the Bradford Selectmen for the right to equip its lines in that town with electricity, and also for a new location at Ward Hill, from the "Boston" Road across Oxford Street, and the cross-road from the Ferry Road to the "Boston" Road at the store.

W. B. SOUTHGATE & CO., manufacturers' agents, 146 Franklin Street, Boston, have been appointed selling agents for the Whitney electrical instruments. As is now quite well known Mr. Henry F. Kellogg is the company of this firm, and it is almost needless to say that his indefatigable energy added to that of Mr. Southgate's is bringing in some handsome business returns for the excellent specialties it represents. An exceptionally good business is being done for the Tilden watchman's time recorder.

THE CREFELD ELECTRICAL WORKS have secured the entire plant of the late Campbell Electrical Supply Company, at Watertown, Mass., and are removing the same to its factory at Saylesville, R. I. As the purchase of this plant included machinery, stock and good will, the Crefeld Company will continue the manufacture and sale of the widely known "Century" line wires and weatherproof tape, the services of the former superintendent of the Campbell Company having been retained. While it is pretty well known, it is at the same time worth repeating, that Bibber, White & Co., selling agents of the Crefeld wire products, are obtaining a strong foothold with the electrical trade.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY has appointed Mr. Calvert Townley its New England agent, to succeed Mr. E. N. Sanderson, who goes to the Pittsburg office in order to be in close association with Mr. Zimmerman, of the executive management of the company. Mr. Sanderson, while in New England, did a good business for the company, and made many friends who will regret his departure. Mr. Townley is in every respect a worthy successor. He has been connected with the company almost from its organization, and has always been closely identified with Vice-President Bannister, whose headquarters are now in New York, and with whom he will be in nearer touch in Boston than if located in Pittsburg.

EXTENSIONS CONTEMPLATED.—The Norfolk Suburban Street Railway Company has voted to make extensive additions to its tracks, and will establish a line to Forest Hills from Dedham, via Germantown, West Roxbury, Roslindale and Mt. Hope, joining the present tracks of the company at this point on Hyde Park Avenue and over this to Forest Hills. As soon as the crossing at Forest Hills is completed, a line will be built from this point up Washington Street and through the newly opened territory of Brandon and Beach Streets, Roslindale. If any difficulty is experienced in crossing the steam railway at Roslindale, the company will ask the right to go under the tracks at a short distance above the railway depot. The company has also voted to extend its Mattapan line to Milton Lower Mills, connecting with the West End Street Railway at Dorchester Avenue. The capital needed to carry out the above projects will be obtained from bonds, which will be offered to the residents of the new localities through which the lines will run.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Aug. 2, 1895.

GEORGE K. HOOPER, who has represented the Abendroth & Root Manufacturing Company for three years as agent and engineer in Chicago, has resigned to accept a responsible position with the Deering Harvester Company of Chicago.

MR. MAX A. BERG, for many years connected with the electric railway department of the Ansonia Electric Company, and afterward secretary of the Wallace Electric Company, Chicago, is now connected with the Ohio Brass Company as its Chicago agent, with offices at 1318 Monadnock Block. Mr. Berg's record in business life is one that any young man could justly be proud of and the Ohio Brass Company is to be congratulated upon securing his services.

F. P. MACK, Chicago agent for William Sumner, who has succeeded to the business of the Underwood Manufacturing Company, of Tolland, Conn., claims that his house is entitled to the credit of having sold the largest belt ever placed in Chicago, which was one of a pair sold the Chicago City Railway Company, each of them being 198 feet long and 62 inches wide. These belts were placed in service in 1892, and have been in use ever since, transmitting 2,000 hp.

THE MANAGEMENT AND CONTROL of the Commercial Electrical Supply Company, St. Louis, Mo., has been changed, the Messrs. Einstein, who heretofore had the control of this company, having disposed of their entire interest to Mr. Joseph Franklin and his son, Mr. Joseph Franklin, Jr. Mr. Franklin, Jr., is president, and his father secretary and treasurer of the company. The new management wishes to thank all customers for past favors, and hopes by increased facilities, good material, prompt shipments and low prices, to greatly extend the business.

THE MICHIGAN ELECTRIC COMPANY, of Detroit, has recently completed an arrangement with the Edison Illuminating Company, of Detroit, and the General Electric Company, covering the selling agency of the General Electric machinery and supplies in Michigan, and, consequently, the General Electric Company will at once close the office it has maintained in Detroit. This arrangement covers the entire line of General Electric product, including lighting generators, motors, incandescent lamps, and all the various lines of machinery and supplies manufactured by the Company, excepting the matter of overhead railway material, in which line the Michigan Company will continue to manufacture and sell the "Michigan" hangers, etc., which have obtained a most satisfactory recognition among the street railway companies. The company has recently engaged Mr. H. E. Baldwin, formerly representing the General Electric Company in Kansas, Missouri, and Oklahoma, who will look after the Illinois State trade, and Mr. L. J. Baldwin will hereafter be in charge of the sales at the company's headquarters. The Michigan Company, which was incorporated about two and a half years ago, has grown rapidly during that period, and to-day has one of the largest and best equipped supply houses in the country. The arrangement with the General Electric Company is one on which both parties are to be congratulated.

General News.

ELECTRIC LIGHT AND POWER.

CONCORD, N. H.—J. C. Atwood, of Lisbon, will establish an electric light plant at the lower dam.

HACKETTSTOWN, N. J.—J. A. Tiger contemplates installing an electric light plant for his store.

CAMDEN, N. Y.—Work has been commenced on the erection of an addition to the electric light station at this place.

CATSKILL, N. Y.—It is reported that James G. Newbury is contemplating the erection of an electric lighting plant.

UNIONTOWN, ALA.—A company is being organized for the purpose of locating an electric lighting plant at this place.

SHELBURNE FALLS, VT.—The residents of this place are agitating the question of building a new electric lighting system.

CHESTER, PA.—A new electric plant is to be erected on the site of the Widener foundry by the Chester Electric Light Company.

JALAPA, MEXICO.—Carlos Yslas, owner of the Luz Electrica de Japala, is contemplating the enlargement of his electric light plant.

CHATTANOOGA, TENN.—C. C. Shelton & Co. are contemplating the installation of an electric lighting plant in their flour mill.

KINGSTON, N. Y.—An electric lighting system is to be installed in the new Cordts engine house in Ponhockie, which has just been completed.

WINDOM, MINN.—Sealed proposals will be received until Aug. 9, by Recorder F. W. Force, for the construction of an electric lighting system.

BALTIMORE, MD.—The Chesapeake Electric Light & Water Company has applied for permission to lay mains under the streets of Highland and Campon.

CORVALLIS, ORE.—The Corvallis Electric Light & Power Company is in the market for an engine and dynamo. J. M. Porter, secretary, can give particulars.

BARDSTOWN, KY.—Bids will be received until Aug. 10 for the installation of an electric lighting plant. The Record Printing Company can furnish full information.

AVOCA, PA.—An election is to be held to vote on the question of lighting the town with electricity. W. F. Whalen and J. A. Coll can furnish detailed information.

ROCKFORD, ILL.—A new electric light plant is to be established here in the near future at an estimated cost of $35,000. The clerk of the City Council can furnish particulars.

NEW WHATCOM, WASH.—The installation of a municipal electric lighting plant is contemplated by the City Council. One hundred arc lights and 2,000 incandescents will be required.

DANVERS, MASS.—A complete electric lighting system is to be established in the court house, and the building will be wired and fixtured throughout for incandescent electric lights.

TOLEDO, O.—Sealed bids will be received until Aug. 19 for the installation of an electric lighting system in the Lucas County court house. Charles H. Jones is county auditor, and can furnish particulars.

ST. BERNARD, O.—Sealed proposals will be received until Aug. 8 for furnishing an electric fire-alarm system for this village. John G. Overman is clerk, and can be addressed for detailed information.

ST. AUGUSTINE, FLA.—It is reported that a company has been organized for the purpose of installing an electric lighting system in this city. E. M. Hammond, of Orlando, is interested, and can be addressed for particulars.

NEWBURGH, N. Y.—The Edison Electric Light Company, of this city, has been consolidated with the opposition company, the Newburgh Electric Light & Power Company. The agreement includes the capitalization of the new company at $250,000. It is to be known as the Consolidated Gas, Electric Light, Heat & Power Company of Newburgh.

NIAGARA FALLS, N. Y.—It has been decided that the proposition of the Buffalo & Niagara Falls Electric Light & Power Company to light Prospect Park without expense to the State shall be accepted, and Superintendent Chapin, of the company, has looked over the ground with Superintendent Welsh. It is expected that the equipment will soon be put in, but it is hardly thought that a searchlight for the Falls will be used this year.

THE ELECTRIC RAILWAY.

AUGUSTA, GA.—It is reported that the electric road is to be extended to the lake.

ENGLEWOOD, N. J.—It is reported that the Palisades Railway is to be extended to this place.

BURLINGTON, N. J.—A new trolley line is to be built on East Broad Street in the immediate future.

BUFFALO, N. Y.—The construction of an electric road from Buffalo to Chicago is contemplated.

ELIZABETH, N. J.—The Consolidated Traction Company will extend its trolley lines in this place.

LOCKPORT, N. Y.—The construction of an electric railway from this place to Olcott is contemplated.

BIRMINGHAM, ALA.—The extension of the North Birmingham electric line into the suburbs is contemplated.

ST. AUGUSTINE, FLA.—The construction of an electric street railway is contemplated by the common council.

BROOKLYN, N. Y.—The Kings, Queens & Suffolk Railway Company will operate a bicycle railway on Long Island.

CLYDE, N. Y.—It is reported that an electric railway is to be built from this place to Bonnicastle in the near future.

FAYETTEVILLE, N. Y.—The Suburban Railway Company has been granted a franchise and will construct a road.

HILLSBORO, TEX.—Arrangements are being made for the construction of the Hillsboro Street Railway Company's line.

GARDINER, MASS.—The electric road is to be extended from the junction of Lake and Park streets to Crystal Lake Park.

WORCESTER, MASS.—The North End Street Railway Company has petitioned for an increase of capital stock to $35,000.

LITTLE FALLS, N. Y.—Work will soon be commenced on the construction of a trolley line between this town and Richfield.

NEW BRUNSWICK, N. J.—The Brunswick Traction Company has applied for right of way through certain streets of the city.

CHAUTAUQUA, N. Y.—The construction of an electric road from this place to Barcelona Harbor, via Mayville, is contemplated.

WOONSOCKET, R. I.—Work has been commenced by the Woonsocket Street Railway Company on the extension of its line.

ELIZABETH, N. J.—A franchise has been applied for to operate a trolley line up Morris Avenue through Sayer Street to Plainfield.

PITTSBURG, PA.—A belt line is to be constructed by the Carnegie Steel Company to connect all its works in this city and vicinity.

OCALA, FLA.—Bonds have been issued for the purpose of building the Ocala & Silver Springs electric road. J. K. Martin can give details.

MEXIA, TEX.—A company is being organized for the purpose of building a railway from this place to Tehaucana, a distance of six miles.

SYRACUSE, N. Y.—The Syracuse & Oneida Lake Railway Company will build and operate an electric railway from Syracuse to South Bay.

ALBANY, N. Y.—The Albany, Greenbush & Bath Railway Company has applied for a franchise to construct an electric railway to Greenbush.

WASHINGTON, D. C.—It is announced that work will begin at once on the construction of the Washington & Baltimore Boulevard Electric Line.

MONONGAHELA CITY, PA.—It is reported that an electric road is to be built from near Little Saw Mill Run to a point near Monongahela City.

BEATRICE, NEB.—The Beatrice Rapid Transit & Power Company has sold its franchise to Victor Lantry. The road will be extensively improved.

STAFFORD SPRINGS, CONN.—Surveys have been completed for the construction of an electric road, and work will be commenced immediately.

YOUNGSTOWN, PA.—A franchise has been secured by the Youngstown Park & Falls Electric Railway Company to North Lima, a distance of 12 miles.

McKEESPORT, PA.—The Versailles Traction Company has decided to erect a large power house in McKeesport, for its line between this city and Boston, Pa.

WASHINGTON, D. C.—The Anacostia & Potomac Railway is to be extended to Congress Heights and equipped with electricity. H. A. Griswold is president.

AUBURN, N. Y.—The Auburn City Railway Company has been granted permission to lay an additional track in Genesee Street between South and Owasco streets.

GARDENVILLE, PA.—It is reported that an electric railway is to be built to this place. Simon J. Martinet is interested, and can be addressed for detailed information.

MANLIUS, N. Y.—An electric railway is projected between this place and Syracuse. Right of way is being secured. Major A. W. Wilkin can furnish detailed information.

PITTSBURG, PA.—A new electric railway is projected to run from the south side. John O'Neill, at the Sixth Avenue Hotel, is interested and can be addressed for information.

BALTIMORE, MD.—It is reported that a road one mile in length is to be built to Chattoleane Springs, by the Pikesville, Reisterstown & Emory Grove Electric Railway Company.

LOWELL, MASS.—West Newbury has voted to appropriate $8,000 toward grading the new highway between Lowell and the ocean, along which it is proposed to build an electric road.

ST. CLOUD, N. J.—A company has been organized for the purpose of building a trolley line from the Highland Avenue station of the D., L. & W over the Orange Mountains to this place.

LONG ISLAND CITY, L. I., N. Y.—A syndicate has been organized known as the Long Island City Heights Association, to build a street railway up Thompson Avenue to Hunter's Point ferries.

BALTIMORE, MD.—A committee has been appointed to secure right of way for an electric line to Witheredsville and Franklintown in the suburbs. P. H. Judik, president of the People's Bank, is interested.

MT. AIRY, OHIO.—The citizens of Mt. Airy held a meeting recently, and appointed a committee to make an effort to have an electric line built from Cincinnati to Mt. Airy and on to Venice, 18 miles distant.

MILWAUKEE, WIS.—The South Milwaukee Advancement Association has expressed its willingness to render financial assistance to any company undertaking to build an electric road from here to Cudahy.

PHILADELPHIA, PA.—The Philadelphia & West Chester Traction Company has authorized an increase of capital stock from $187,800 to $400,000 for the purpose of completing the road and putting it into operation.

SUSQUEHANNA, PA.—The Susquehanna Electric Light Company and other parties are figuring upon the cost of building an electric railway between Susquehanna and the Delaware & Hudson Station at Lanesboro.

PITTSBURG, KAN.—The Kansas & Missouri Electric Railway Company has been chartered for the purpose of constructing a railway line in Crawford County. Samuel Barrett and Robert Bobbin, of this place, are interested.

ANDOVER, MASS.—The Lawrence & Reading Street Railway Company is to construct and operate a street railway between the points named. Charles F. Woodword, of Wakefield, is interested, and can be addressed for information.

ELIZABETH, N. J.—The transportation of United States mail by the trolley line between this city and Newark is being discussed, and it is not improbable that an arrangement will be consummated for the establishment of the service.

ATLANTA, GA.—The Consolidated Street Railway Company will extend its line in various directions, including the extention of the Whitehall Street line to Fort McPherson, and the Peachtree Street line about a mile and a half northward.

MILFORD, MASS.—An electric railway, six miles in length, is to be constructed between this place and Medway, at an estimated cost of $100,000. C. W. Shippee and G. M. Green of this city are interested, and can be addressed for information.

NORFOLK, VA.—It is reported that the Norfolk, Albemarle & Atlantic Company is contemplating the changing of its line to standard gauge and equipping with electricity. D. P. Holland is superintendent and can furnish detailed information.

Trade and Industrial Notes.

THE NEW BRITAIN MACHINE COMPANY, of New Britain, Conn., has acquired all patents and property of the Case Engine Company, as well as adjoining land for the increase of the business, and will continue the manufacture of the well-known Case engine.

THE C. W. HUNT COMPANY, 45 Broadway, New York, has sold the Taylor Iron & Steel Company, of High Bridge, N. J., a complete equipment of cars and track for handling its material, and the Otis Company, of Ware, Mass., has again added to its already very complete system of Hunt industrial railways.

FORTHCOMING.—The Bryant Electric Company, of Bridgeport, Conn., will issue a new catalogue this Fall, which will contain a number of new specialties. Thos. G. and Edward R. Grier, managers of the Western office, are at work on some new devices, and no doubt the coming season will see the Bryant Company putting out some new specialties of much merit.

THE STANDARD TELEPHONE & ELECTRIC COMPANY, of Madison, Wis., has issued a pamphlet catalogue describing its telephone sets, which are supplied with the Milde transmitter. This transmitter is unusually powerful, and possesses the advantage of requiring no adjustment whatever. The Standard Company recently acquired full control of this transmitter for the United States and make some exceedingly strong claims for it, declaring a willingness to back up the claims to the full satisfaction of the purchaser.

THE SWARTS METAL REFINING COMPANY, 120 West Lake Street, Chicago, has issued a substantially bound catalogue descriptive of the various anti-friction metals made by it, which will be found of interest to station managers. One of the departments of this enterprising firm is devoted to the handling of scrap metals, which business has assumed vast proportions, particularly in Chicago. It is estimated that the scrap metal business in that city alone amounts to not less than $3,000,000 per annum. Nearly the entire amount of scrap accumulated throughout the Western and Southern states is marketed there.

E. B. LATHAM, 136 Liberty Street, New York, Eastern manager of The Lakon Company, of Elkhart, Ind., manufacturers of transformers, has recently closed contracts for transformers aggregating 12,000 lights capacity. Mr. Latham has accepted the agency for George Cutter's electrical specialties for New York State. These specialties include the well-known safety sleet-proof arc lamp pulley, incandescent street fixtures, high-potential switches, "Clincher" tape and splicing compounds. Mr. Latham's success as Eastern manager for the Lakon Company and in other branches of electrical business is a guarantee that Mr. Cutter's interests will not suffer in his hands.

PRESERVATION OF STEAM BOILERS.—The Vielle Montague Company Belgium, of which H. Lamarche's Sons, 83 John Street, New York, are the, agents, has issued an interesting circular calling attention to the use of spelter for the disincrustation and preservation of steam boilers. Several instances are described showing the very effective manner in which it performs these functions, and directions are given as to the quantity of spelter to use for a given case. The circular recommends that soda may be used in connection with the spelter, about six pounds to 100 hp for the engine each 12 hours, and that 45 pounds of spelter be employed for each 100 hp for three months.

A SMOKELESS COAL.—Superintendent of Motive Power William Garstang, of the Big Four Railway, and William S. Morris, Superintendent of Motive Power for the Chesapeake & Ohio Railway, are very enthusiastic over the success on their respective lines in the use of New River smokeless coal. It has been given a thorough test on the passenger engines of both lines, and in addition to abating the smoke nuisance has been found to be very economical. The city of Chicago used over one hundred thousand tons of this coal last year. The coal is mined on the line of the Chesapeake & Ohio Railway along New River, and transported via that line in connection with the Big Four.

THE BOUDREAUX DYNAMO BRUSH COMPANY, 253 Broadway, New York, recently received a letter from the Indiana Paper Company, of South Bend, Ind., as follows: "You perhaps will not refuse to accept an unconditional surrender, coming, as it does, from parties who have already condemned your goods; but we beg to assure you that having discovered that the fault lies with us, not with your brushes, we hasten to right the wrong so unjustly forced upon you. We had been having trouble, but were unable to locate it. There being no barrier to placing it on 'the other fellow' we unhesitatingly did so. A change in brushes did not seem to help matters and we commenced a search. We can now say that 'Your brushes are more than we anticipated.' We want a duplicate of your shipment to us March 7." This story certainly carries the moral that a really good thing is often made the scapegoat for a sin in no way its own.

THE SHEFFIELD CAR COMPANY, of Three Rivers, Mich., has just issued a very attractive catalogue of its well-known railway velocipedes and handcars. This catalogue is designated as "Special Foreign Edition," from the fact of its being printed in four languages—English, French, German and Spanish. The book is copiously and artistically illustrated. The issuance of this catalogue was deemed expedient in view of the very gratifying increase in foreign business. The Sheffield Company is now making a novel mining or tunnel velocipede, which has already worked itself into universal favor wherever it has been tried. This machine is designed for narrow-gauge tracks, and is so constructed that there are no projections extending beyond the track, so that it can be used in close quarters without any liability to hang in a narrow tunnel. The velocipede is intended for a single person, and is made for tracks of any gauge down to 17 inches.

A NICE CATALOGUE is being distributed by the Lane & Bodley Company of Cincinnati, Ohio, containing detailed descriptions and a quantity of well-executed illustrations of the Columbian-Corliss engines made by the company, which are exceedingly simple and strong in design. The frame is the box-section type, the most rigid for a given weight that it is possible to construct, and is cast in a single piece with the main journal pedestal and cross-head slide pedestal. The connecting-rod is of the solid-end type, dispensing with the strap commonly used, and affording much more reliable construction. Explicit directions are given for the erection of these engines, the adjustment of the valves and the care of the governor and its gear, and the catalogue closes with valuable suggestions to intending purchasers of engines, regarding the relative conditions under which various types are to be preferred.

A MASTERPIECE.—One of the most interesting, best executed and most intelligently prepared of advertisements is a book entitled the "Car-buyers' Helper," which has been issued by the Brownell Car Company, of St. Louis, Mo. The book is elegantly printed on good paper, handsomely illustrated and substantially bound in cloth. Many points are brought out upon which the average buyer is seldom posted, and the smallest details of construction are thoroughly explained. Particular attention is called to the merits of the "Accelerator" door arrangement, which consists of placing two separate doors in the end of the car, the one nearest the outside step being used. This disposition gives practically double the platform space available without obstructing the doorway. A most valuable feature of the book is a guide for the preparation of specifications, in which the smallest and apparently most insignificant parts of the car are considered. The purchaser is vigorously cautioned against cars built in extra short time, the rational argument being made that a car cannot be built from the start within the time required for proper painting, and still be a first-class job.

Business Notices.

ELECTRIC LEAGUE.—Meets every Thursday evening, 100 West 24th street, New York. Electrical engineers and electricians cordially invited.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren Street, Syracuse, N. Y.

ELECTRICAL FIRMS thinking of handling bicycles are very anxious to obtain the agency of some wheel that is not in the repair shop oftener than on the road. When we recommend the Keating, which is advertised on page ix, we believe we are recommending the staunchest light bicycle in the country.
THE KEATING WHEEL CO.

ALL ABOUT BLOCK SIGNALS.—"Block Signals on the New York Central," the latest addition to, and No. 17 of the popular "Four-Track Series" of "America's Greatest Railway," is from the press of the American Bank Note Company; contains 64 pages, narrow octavo, beautifully printed on coated paper and illustrated with graphic pictures of signal apparatus and its application to the traffic of a great railway. The text is from the pen of a celebrated English expert on block signals, and the subject is treated in a way that cannot fail to interest the average traveler, as well as the technical engineer. It is believed that this, the latest of railway safety devices, has never before been so thoroughly and comprehensively described and illustrated as in this book. A copy will be mailed to any address, free, post paid, on receipt of three two-cent stamps, by George H. Daniels, General Passenger Agent, Grand Central Station, New York.

"TWO TO FIFTEEN DAYS' PLEASURE TOURS."—This is a beautiful little book of 64 pages, narrow octavo, printed in two colors, issued by the Passenger Department of the New York Central, from the press of the Matthews-Northup Company Complete Art Printing Works, Buffalo, N. Y. It describes a series of tours occupying from two to fifteen days, arranged for the purpose of meeting the wishes of all classes of travelers, including trips to the Thousand Islands, Montreal, Saratoga, Lake George, the Catskill Mountains, Niagara Falls, Chautauqua, Adirondack Mountains, Berkshire Hills, Richfield Springs and many other famous resorts. Information concerning these trips is given—distances, time, fares, connections and all other details—with much precision. It contains ten maps engraved expressly for this work, and is profusely illustrated with a large number of new and beautiful half tone engravings. A glance over the pages of this little book will convince you that the attractions of the New York Central are equalled only by their merit, and afford a choice which will suit every taste and every purse. "Two to Fifteen Days' Pleasure Tours" will be sent free, post paid, to any address in the world, on receipt of two two-cent stamps, by George H. Daniels, General Passenger Agent, New York Central & Hudson River Railway, Grand Central Station, New York.

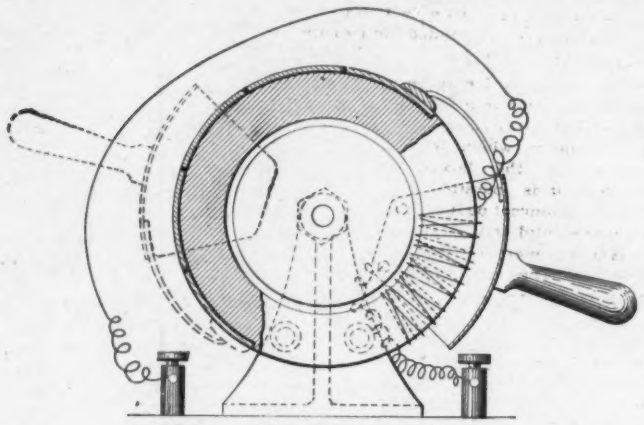
Illustrated Record of Electrical Patents.

PATENTS ISSUED JULY 30, 1895.

543,351. ELECTRIC BRAKE; W. B. Potter, Schenectady, N. Y. App. filed March 23, 1895. The combination of a motor car and a trailer, an auxiliary normally idle dynamo, and means whereby the accidental separation of the two cars will close the auxiliary generator upon a local circuit acting to stop the trailer car.

543,490. CONTRIVANCE FOR DISINFECTING TELEPHONE APPARATUS; R. Lamarche, Hamburg, Germany. App. filed July 24, 1894. A contrivance consisting of a tube in the form of an annular ring placed at the mouthpiece of the telephone, said tube having a number of perforations and being provided with a rubber ball connected thereto for the reception of the disinfecting materials.

543,495. ELECTRICALLY CONTROLLED ELEVATORS; C. O. Mailloux, New York, N. Y. App. filed May 28, 1895. A system comprising a controlling switch at each landing for calling the car to that landing, duplicate switches corresponding to the controlling switches at other landings whereby the car may from one landing be directed to any of the others.



No. 543,564.—Reactive Coil.

543,502. ELECTRIC ARC LAMP; S. E. Nutting, Chicago, Ill. App. filed April 5, 1894. The combination of an electromagnet having a core in bar form, and its faces divergent, a forked armature moving transversely to the polar axis of the magnet, and having its arms spaced apart so as to embrace both poles of the magnet, and mechanism actuated by the magnet for controlling the carbon feed of the lamp.

543,523, filed Nov. 14, 1894, 543,524, filed Dec. 6, 1894, 543,525, filed Feb. 9, 1895. BRAKE MECHANISM FOR ELECTRIC MACHINERY; J. P. B. Fiske, Alliance, Ohio. The combination of a movable frame, having a fixed frame within and devices for starting, stopping and controlling the same.

543,529. ELECTRIC TROLLEY; G. W. HOOPER, Rochester, N. Y. App. filed Sept. 11, 1894. A trolley having a yoke with transverse openings in its ends, a wheel with a hollow shaft bushings at the outer ends engaging the yoke and extending inwardly to receive the end of the hollow shaft, and a clamping bolt to prevent spreading of any of the parts.

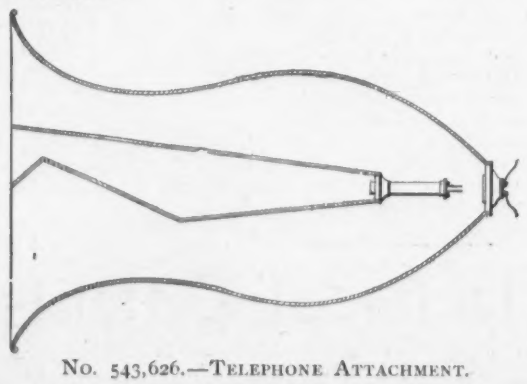
543,559. SIGNALING APPARATUS FOR TELEPHONE EXCHANGE CIRCUITS; J. J. O'Connell, Chicago, Ill. App. filed May 14, 1895. The combination of a main line and two local signal circuits at a station, connected with suitable switches, a relay in the main circuit, opening and closing switches at two points of each signal circuit, so arranged that the signals of either circuit can only be displayed when both ends of it are closed.

543,564. REACTIVE COIL; E. E. Stark, New York, N. Y. App. filed Feb. 21, 1894. The combination of a part made of iron laminæ, with a wire forming part of an electric circuit wound around it, a shield or hood also encircling it, reverse coils or windings electrically connected to said coil, and means for successfully shunting portions of said coil through these reverse coils or windings.

543,591, filed Nov. 17, 1892; 543,592, filed Oct. 5, 1893; 543,593, filed Feb. 14, 1894; 543,594, filed July 10, 1894; 543,595, filed Aug. 20, 1894; 543,596, filed Aug. 20, 1894; 543,597, filed Aug. 20, 1894. ELECTRIC SIGNALING SYSTEM; T. B. Dixon, Henderson, Ky. A system to automatically ascertain the movements of trains.

542,613. MANHOLE FOR UNDERGROUND CONDUITS; J. F. Cumming, Detroit, Mich. App. filed Nov. 6, 1894. A manhole having a cylindrical outer box, with a large top formed with a plurality of seating flanges, and covers supported by the said flanges, the inner box supported by insulated studs.

543,616. INTERNAL ILLUMINATOR AND PROBE; W. E. Dow, Braintree, Mass. App. filed Feb. 16, 1895. A tubular lamp carrier having a lamp at its end, a mirror support having a tubular portion at one end adapted to slide concentrically upon the said tubular carrier, and hinged to the end of the said mirror support.



No. 543,626.—Telephone Attachment.

543,626. TRANSMITTING AND RECEIVING ATTACHMENT FOR TELEPHONE; H. W. Libbey, Boston, Mass. App. filed Oct. 9, 1894. A device consisting of an outer casing to receive the voice to be transmitted and convey it to the transmitter and an inner casing to receive the voice from the receiver and deliver the same.

543,654. ELECTRIC SOLDERING IRON; F. B. Rae, Detroit, Mich. App. filed Sept. 18, 1894. The combination of a brace, a soldering iron and a supporting standard, conductors terminating at the top of the brace, an adjustable swivel cap and a switch in the said cap.

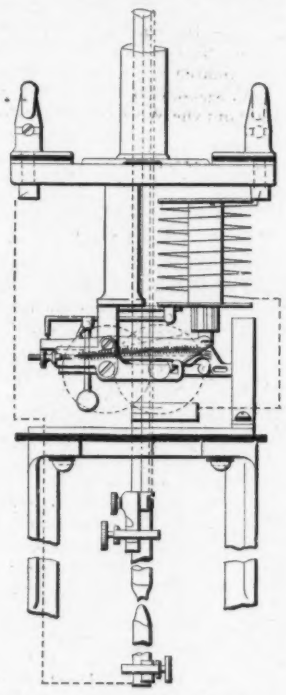
543,670. FOUR-MOTOR REVERSING SWITCH; F. E. Case, Schenectady, N. Y. App. filed May 15, 1895. The combination of three rows of contacts mounted on a cylinder, two sets of brushes engaging therewith, the middle and one set of outer contacts being connected so as to cause the motors to revolve in one direction and the other contacts causing them to revolve oppositely.

543,680. SECONDARY VOLTAIC BATTERY; L. Epstein, London, Eng. App. filed Jan. 5, 1895. The combination of a negative plant made of gauze electrically coated with zinc, with positive plates inserted between the negative plates, and revolving agitators of insulated material interposed between the opposed surfaces of the positive and negative plates.

543,707. ELECTRIC CLOCK-WINDING MECHANISM; W. S. Scales, Everett, Mass. App. filed Nov. 12, 1894. The combination of an electromagnet having an armature vibrating toward and away from its poles an actuator, a reciprocating momentum device connected with said actuator, made independent but which can be operated in one direction by the armature so as to thrust up a bar and so wind up the clock mechanism.

543,708. TELEPHONE EXCHANGE; W. Y. Shibata, San Francisco, Cal. App. filed Nov. 24, 1893. The combination of parallel conducting bars having metallic bars secured thereto, tracks mounted on said plates and cars adapted to travel above the plates on the tracks, the movement of the cars bringing into contract an electromagnet and opening communication with desired points, and cutting off all others.

543,729. ELECTRIC ARC LAMP; C. E. Harthan, Lynn, Mass. App. filed Nov. 21, 1894. A lamp having carbons and a feeding mechanism with a



No. 543,729.—Arc Lamp.

magnet receiving alternating currents whose core controls the said feeding mechanism, and a spring arranged to progressively assist the movement of the core.

543,743. HOT-BOX INDICATOR FOR RAILWAY CARS; L. Lyndon, Athens, Ga. App. filed Dec. 13, 1894. The combination of an indicator and a contact device mounted on each journal throughout the train, whereby when the said journal reaches a certain degree of heat, the circuit is closed, and the indicator in the cab registers the fact.

543,785. RAILWAY SIGNALING; J. G. Schreuder, Edgewood Park, Pa. App. filed March 28, 1894. A system comprising a differentially wound relay, the winding in one direction being greater than in the other, the greater coil being included in a track circuit, and a normally closed signal circuit controlled by the relay, and including therein the lesser coil of the relay.

542,793. SWITCH AND SIGNAL MECHANISM; J. V. Young, Boston, Mass. App. filed Aug. 23, 1894. The combination of the movable part of a switch and signaling apparatus provided with a projection having an inclined face with a pivotally mounted arm automatically movable into locking relation with the movable part and provided with a notch having an inclined face and so located that the distance from the notch to the free end of the arm is greater than the distance from the notch to the pivotal point, and an electromagnet provided with an armature for engaging the free end of the arm and holding the same in locking position.

513,800. ELECTRIC HEATING RUG; J. R. Davis, Parkersburg, W. Va. App. filed July 11, 1894. The combination of a flat layer of electric heating medium of amorphous resisting material, a ring-shaped electrode of triangular cross-section having its flat face uppermost, a second electrode of conical shape arranged with its base uppermost and in concentric relation to the ring, both being arranged in the same plane in the heating medium, and an insulating casing with flexible covering.